DOCUMENT RESUME

ED 167 451 SO 011 525

TITLE	Energy and Conservation Education: Activities for the Classroom, Grades 7-9.
INSTITUTION	Energy and Man's Environment, Inc., Portland, Oreg.
PUB DATE	78
NOTE	308p.; For related documents, see SO 011 523-529; Photographs throughout document may not reproduce clearly
AVAILABLE FROM	Energy and Man's Environment, 0224 S.W. Hamilton, No. 301, Portland, Oregon 97201 ($24.00)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	Class Activities; Classroom Games; Concept Teaching; *Conservation Education; Depleted Resources; Educational Objectives; *Energy; *Energy Conservation; *Environmental Education; Environmental Influences; Fuels; Futures (of Society); Grade 7; Grade 8; Grade 9; Instructional Materials; Interdisciplinary Approach; Junior High Schools; *Learning Activities; Natural Resources; Secondary Education; Social Studies; Student Evaluation; Teacher Developed Materials; Teaching Guides

ABSTRACT

The instructional materials and classroom activities described in the document are intended to aid teachers in grades seven through nine develop and implement educational programs dealing with energy-related issues. The document is presented in four sections. Section I explains the organization of the document and summarizes how teachers should implement activities and assess student performance. Section II consists of a matrix of activities described in the document. Information is presented on grade level, time required, and subject matter. Section III describes learning activities in six areas: (1) sources of energy, (2) uses of energy, (3) conversion of energy from one form to another, (4) impact of energy use on the environment, (5) limits of the earth's resources, and (6) the future. For each activity, information is presented on title, concept, time, implementation, materials, and optional activities. Activities involve students in performing and observing energy-related experiments such as starting fires with magnifying glasses, debating the merits of various fuels, compiling lists of energy sources used in industrial and commercial production, discussing energy issues with classmates and resource people, defining terms, and completing handouts. The final chapter presents information on student assessment. Suggested test items are presented along with suggestions on how to use them and an explanation of the origin of test items. (DB)

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ED167451

ENERGY AND CONSERVATION EDUCATION

Activities for the Classroom

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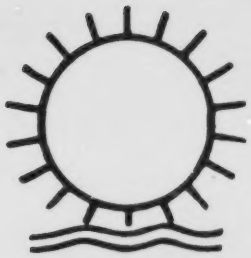
Grades 7-9

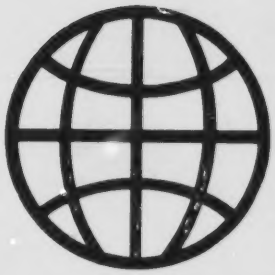


SOURCES

FUTURE

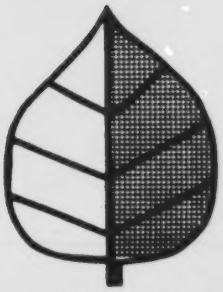
EME

USES



LIMITS

CONVERSIONS



IMPACTS

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ENERGY & MAN'S ENVIRONMENT

PRESIDENT: DR. JOHN JONES

PROGRAM DIRECTOR: ED DALTON

Curriculum Coordinators and Editors:

Daniel B. Grimes
- Oregon State Coordinator, EME; Portland, OR
- Elementary Program Specialist, Oregon State Department of Education; Salem, Oregon
- National Consultant, Career Education/Energy and Environmental Education
- Former Elementary Teacher, Beaverton School District; Beaverton, Oregon

Duane K. Altig
- Secondary Teacher, Parkrose Schools; Portland, OR
- Oregon State Department of Education Career Exploration Cadre Member
- National Consultant, Career Education/Economics
- Secondary Curriculum Consultant/Project Director Oregon Council On Economic Education
- Member ASCD

Address Order & Information Requests to:

Energy & Man's Environment
0224 S.W. Hamilton
Suite 301
Portland, OR 97201

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CREDITS

The Learning Activity Packages are the result of a three-year development effort by Energy & Man's Environment and educational agencies in the Northwest. The development project was designed to produce practical and objective energy and conservation education classroom resources.

Phase I of the development process began in 1972, when educators and industry representatives met under the leadership of the Washington State Department of Public Instruction to establish a framework of goals and objectives essential to an understanding of energy and energy-related environmental issues. Six principal topic areas were identified: Sources of Energy, Uses of Energy, Conversion of Energy, Impacts of Energy, Limits of Energy and Future Sources of Energy. Each topic was described in the form of multidisciplinary goals, concepts and objectives. The framework was expanded into an Activity Guide and subjected to testing and revision. This Guide appeared at the beginning of the energy dilemma and served as a model for many subsequent efforts across the United States. Contributors to the first edition of the Guide were:

La Von Bucher, Teacher
Dick Downie, Engineer
Dan Horn; Professor, Earth Science
David Kennedy; Administrator, Environmental Education
Joyce Lekas, Teacher
Don Orlich; Professor, Education
Thomas Ris, Communications
Elaine Smith, Teacher
Loretta Smithburg, Teacher
Dave Stronck; Professor, Education/Biology
Lyle Wilhelmi; Administrator Science

The second phase of the instructional materials development began in 1973. With the assistance of state departments of education, EME selected and contracted with six outstanding school districts to develop teacher-made instructional materials based on the Activity Guide framework. The districts selected were Cheyenne, Wyoming; Everett and Olympia, Washington; and Beaverton, Eugene and Medford, Oregon. Key Area Resource Persons in Phase II were Bob Larson, Larry Torgerson, Floyd Smith, Lois Helton, and Lyle Wilhelmi. Phase II continued for nine months and produced a wide range of multidisciplinary, 1-12 instructional resources.

In September, 1974, Phase III of the curriculum writing effort began with the awarding of a substantial contract to the Beaverton, Oregon School District. Under the direction of Lois Helton, a team of master teacher writers scrutinized, refined and rewrote the materials produced in Phase II. The team was composed of Dan Grimes, Mabel Lund, Shirley Barnes, and Ted Parker. Essential to the success of this effort were Dalton Plunkett and Harold Wik, who provided leadership and facilitated the development process. Chloe Poole and Omer Gosnell added their creative skills to design and illustration.

Concurrent with the initiation of Phase III, a skilled group of writers from business, industry, government and the private sector came together to revise and strengthen the Activity Guide. Utilizing several hundred evaluations from teacher users, the writers refined the conceptual framework, expanded the resource material and created a new organizational structure. The result was a set of seven Activity Guides described by one leading curriculum administrator as "the single richest source of energy and conservation education teaching ideas available anywhere." The new material was used by Phase III writers and keyed to the expanded framework of topics, concepts, and instructional objectives. Authors of the new Activity Guide were:

La Von Bucher, Teacher
George Carter, Energy Information
Don Charnley; Attorney, Legislator
Ed Dalton, Teacher
Roberta Davis, Parent
Dick Downie, Engineer
Lois Helton, Teacher
Dan Horn; Professor, Earth Science
Bob Keesey, Economist
Dave Kennedy; Administrator, Environmental Education
Al Krieg, Engineer
Ron Lamb; Professor, Biology
Keith Loeffler, Energy Information
Jack Vogel, Energy Information
Harold Wik; Administrator, Curriculum
Lyle Wilhelmi; Administrator, Curriculum
Warren Wolf, Art School Director

In 1975, Learning Activity Packages from Phase III were placed in Beaverton, Oregon and Everett, Washington schools and subjected to vigorous classroom evaluation. External, third-party assessment was instrumented and supervised by Dr. Quentin Clarkson of Portland State University. Supervision at the school district level was managed by Wayne Neuberger, Evaluation Specialist for the Beaverton School District, and Jim Pringle in the Everett, Washington School District. Teacher evaluators in the Beaverton and Everett School Districts included:

Jim Pringle	Cascade High School
Marlene Lindstrand	Cascade High School
Dave Dailey	Cascade High School
Elliot Cheap	Cascade High School
Tony Jongejan	Everett High School
Shirley Barnes	West Tualatin View Elementary
Cindy Claridge	Beaverton School District #48
Jackie Fitzgerald	William Walker Elementary
Maria Gander	West Tualatin View Elementary
Dan Grimes	William Walker Elementary
Lois Helton	Five Oaks Middle School
Pat Kingman	Aloha Park Elementary
Mabel Lund	Mountain View Middle School
Rowena Marks	West Tualatin View Elementary
Jim Miller	Aloha High School
Shari Noldge	William Walker Elementary
Court Ofelt	Mountain View Middle School
Ted Parker	Aloha High School
Joanne Profitt	Five Oaks Junior High School
Kathy Vassias	Beaverton School District #48
Bruce Weitzel	Five Oaks Middle School
John West	Five Oaks Middle School

The final step in development, Phase IV, began in September, 1976. Under the direction of Dan Grimes, EME Oregon Coordinator, and Duane Altig, Parkrose School District, each Learning Activity Package was examined and revised based upon the field test evaluation. Production assistance was provided by Darlene McLaughlin, Sharon Scherner, and Jane Aldrich.

Many persons not specifically named here contributed personally to the success of this major undertaking. Among those not already mentioned were Helen White, Diane Nelson, Luanne Campbell, Marcia Whitelock, Doris Graffam, and Roberta Davis. To those teachers, students, curriculum specialists and parents who remain unnamed but gave so freely of their time and skill, we extend our sincere and grateful appreciation. We hope our effort will materially benefit our teaching colleagues.

John Jones, D.Ed.
President
Energy & Man's Environment
Portland, Oregon

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Goal:

It is essential that each person know that there are many sources of energy.

Section Two — Uses

Goal:

It is essential that each person know that people are dependent upon energy.

Section Three — Conversion

Goal:

It is essential that each person know that energy can be converted from one form to another.

Section Four — Impacts

Goal:

It is essential that each person know how humankind's use of energy creates an impact on the environmental and economic systems.

Section Five — Limits

Goal:

It is essential that each person know that the earth's resources are limited.

Section Six — Future

Goal:

It is essential that each person know that new energy sources and more efficient systems, accompanied by different consumption practices, may alter the world energy dilemma.

IV. STUDENT ASSESSMENT

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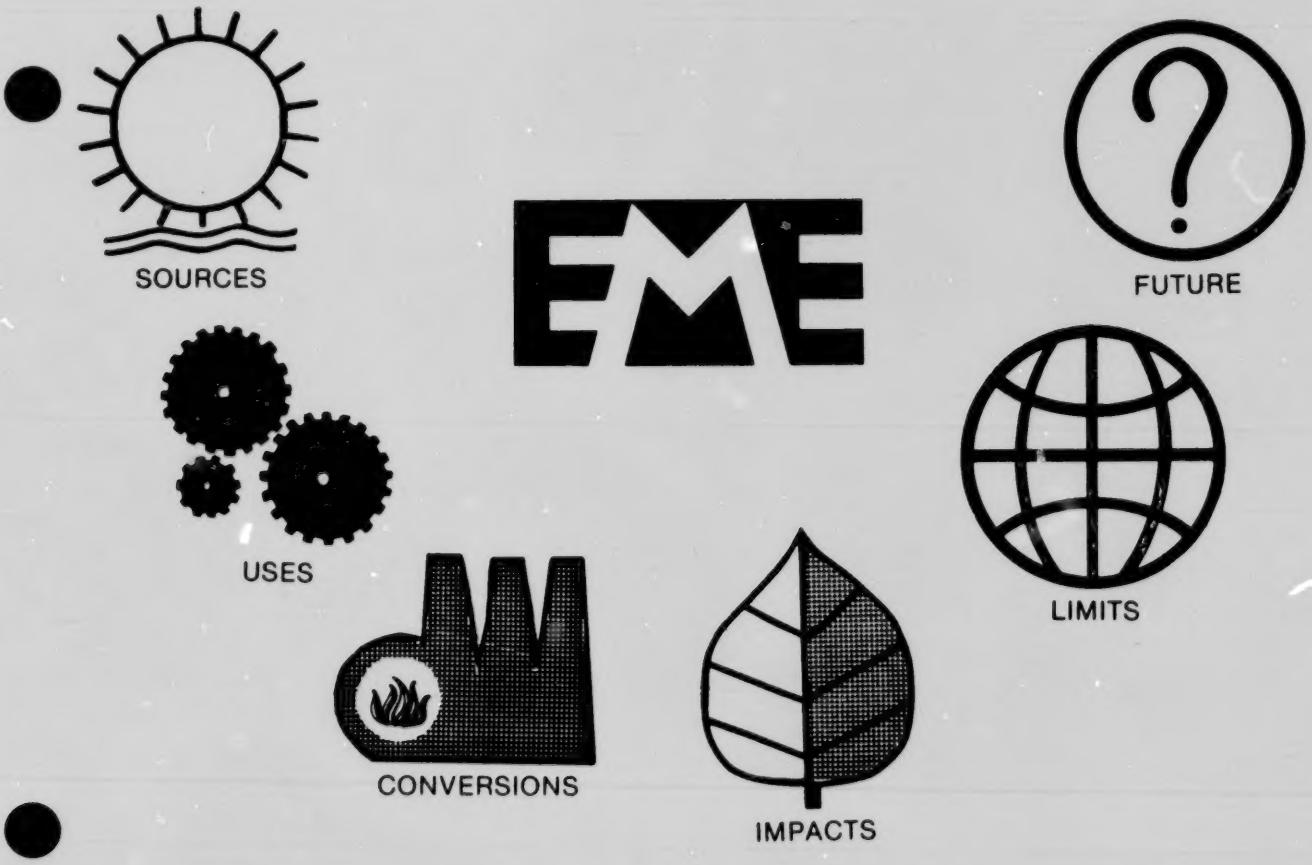
IMPLEMENTATION HANDBOOK

ENERGY AND CONSERVATION EDUCATION

Activities for the Classroom

Grades 7-9



ACTIVITY NOTEBOOK

IMPLEMENTATION HANDBOOK

Overview

Energy & Man's Environment (EME) is a unique educational program developed to prepare instructional materials dealing with energy education--primary grades through high school. EME was initiated in 1972 by the Public Power Council of the Northwest Public Power Association in cooperation with leading educators in the region. In 1973, members of the Northwest Electric Light & Power Association (NELPA) joined the program. In 1976, additional business, governmental and educational agencies joined the Northwest consortium to strengthen EME efforts. The precedent of cooperative effort has resulted in an educator-directed, non-profit corporation supported by resources from business, government, education, and the private sector. The program has one goal--to make the subject of energy understandable both to the educator and the student. EME's primary concern is to present energy-related issues from all points of view accurately and objectively. EME offers conferences, workshops, seminars, speakers, and special programs to meet the energy-related needs of educators. Each activity can be "custom tailored" to meet the specific needs and interest of the participants.

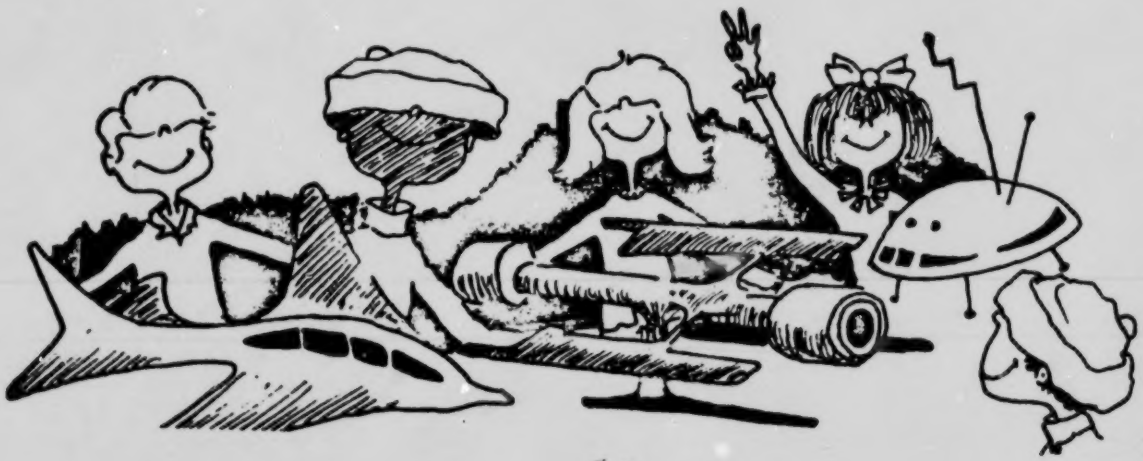
The educational materials presented in the EME Activity Notebooks 1-12 are an example of the teacher-prepared materials offered by EME for use by classroom teachers in presenting energy-related issues.

Organization

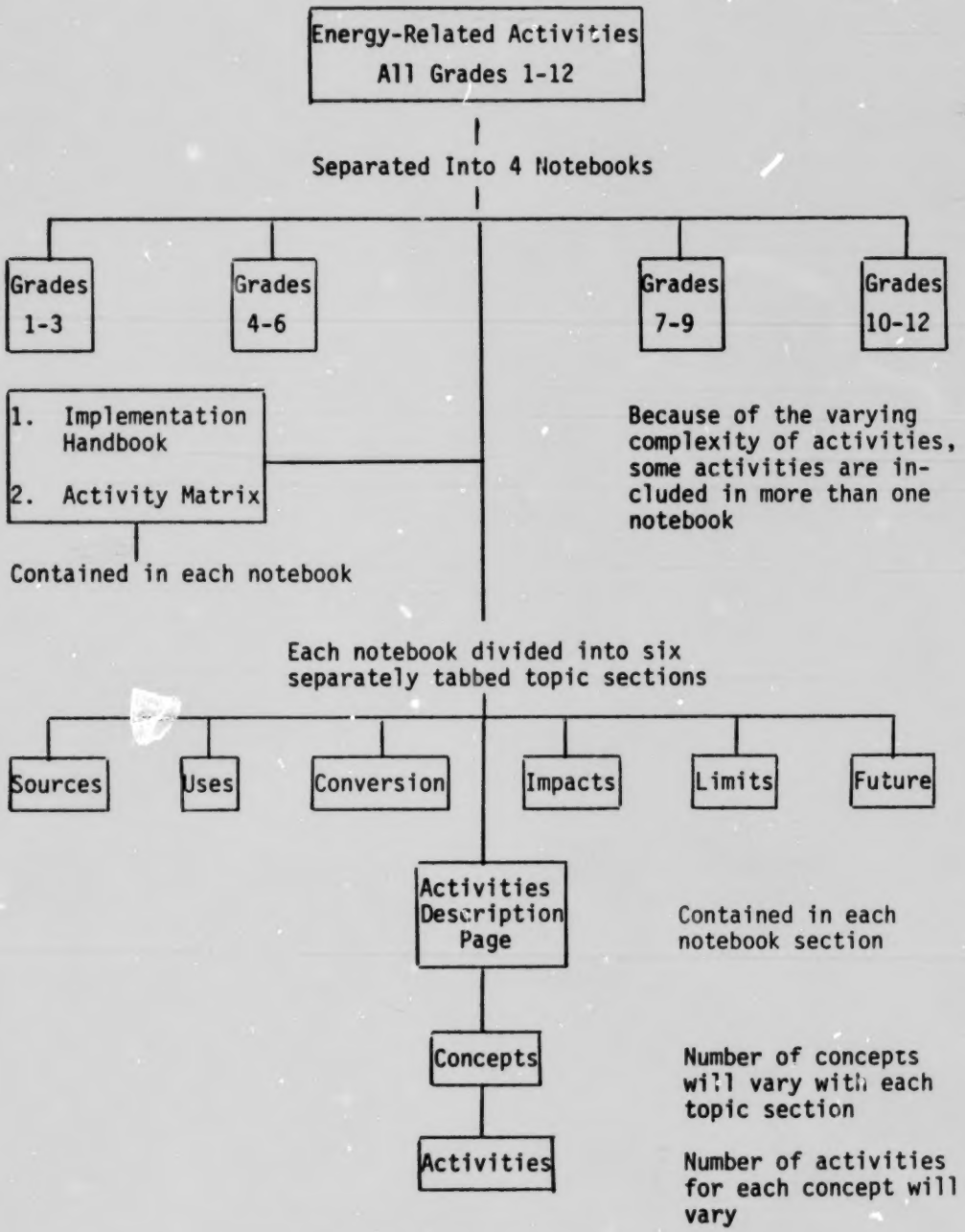
There are four notebooks covering all grade levels 1-12. The arrangement of the notebooks are (1-3), (4-6), (7-9), (10-12). Because of the varying complexity and multidisciplinary nature of the activities, each notebook includes an implementation handbook and an activities matrix which identifies topics, activities, grade levels, subject matter areas, etc. for quick reference by the teacher. The individual notebooks contain activity description pages for each of the six topics in the notebook.

The six principal sections or topics in each notebook are: Sources of Energy, Uses of Energy, Conversion of Energy, Impacts of Energy, Limits of Energy, and Future Sources of Energy. Each topic contains a number of concepts which are necessary to a fundamental understanding of the general topic area. Listed under each concept are simply stated objectives or activities which are multidisciplinary in nature and vary in their complexity. Included within each of the activities is a complete breakdown as to the time needed for implementation of the materials, implementation procedures, assessment procedures, a suggested career education activity, and other information necessary for successful classroom use of the activities.

The following diagram will help to explain the notebook organization. The concepts which provide an overall guide to the intent of the main topic are within the description pages of the notebook. The activity objectives indicate the expected level of outcome from the materials to be presented in the classroom. Each activity is the "hands-on" experience which the student will accomplish to meet the expected outcome.



EME ACTIVITY NOTEBOOK ORGANIZATION



Teacher Implementation

The materials are designed to be used by classroom teachers in all grade levels. It is hoped that the instructors will feel free to alter, adapt or change the activities to meet their own particular classroom needs and the needs of their students.

Some of the skills and concepts in the activities should be presented more than once to any given group of students. Therefore, in some instances, it may be desirable to repeat the activity at another grade level--either in its original or in an altered form.

Most of the activities require the students to be actively involved, both with other students and in actual use of the materials. This may require some adjustment of the traditional classroom situation.

There are many activities which contain handouts that can be duplicated for student use.

The actual use of the notebooks is relatively simple. Steps to locating a suitable activity are:

1. Select appropriate notebook.
2. Read activities matrix to select an activity title and number which most closely matches your interest, grade level, and subject matter.
3. Turn to the topic section of the notebook indicated by the activities matrix.
4. Read the description of the activity you selected, and then turn to the activity number in the notebook.
5. Read the activity.
6. Complete the activity. (Repeat these steps for additional activities.)

Assessment

Included in each notebook are a series of sample test items for the teacher who wishes to pinpoint areas of weakness and strength in the individual student's knowledge of energy topics.

The test items are written so as to be easily understood by a majority of students. The sample questions are not definitive items and are not intended to be the final word on the materials in the notebook. Each of the activities has its own assessment procedures and these should also be utilized by the instructor. The test items may be used as an indicator of the general skill and knowledge level of students prior to the implementation of EME Lesson Plan Notebooks, or as a check on the retention level of students who have been presented materials from the EME Lesson Plan Notebooks. It is recommended that the teacher remain the ultimate judge as to the effectiveness of the activities as they are presented to the students, either in their original or instructor-altered form.

Follow-Up

The materials contained in the notebooks are continually undergoing extensive field testing and revisions to obtain the best possible materials to present to students. In the event that you, as a classroom teacher, wish to contribute more to the program of energy education, EME would be happy to hear from you. If you have any suggestions which could improve any phase of the organization, activities, etc., please contact EME headquarters.

Duane K. Altig

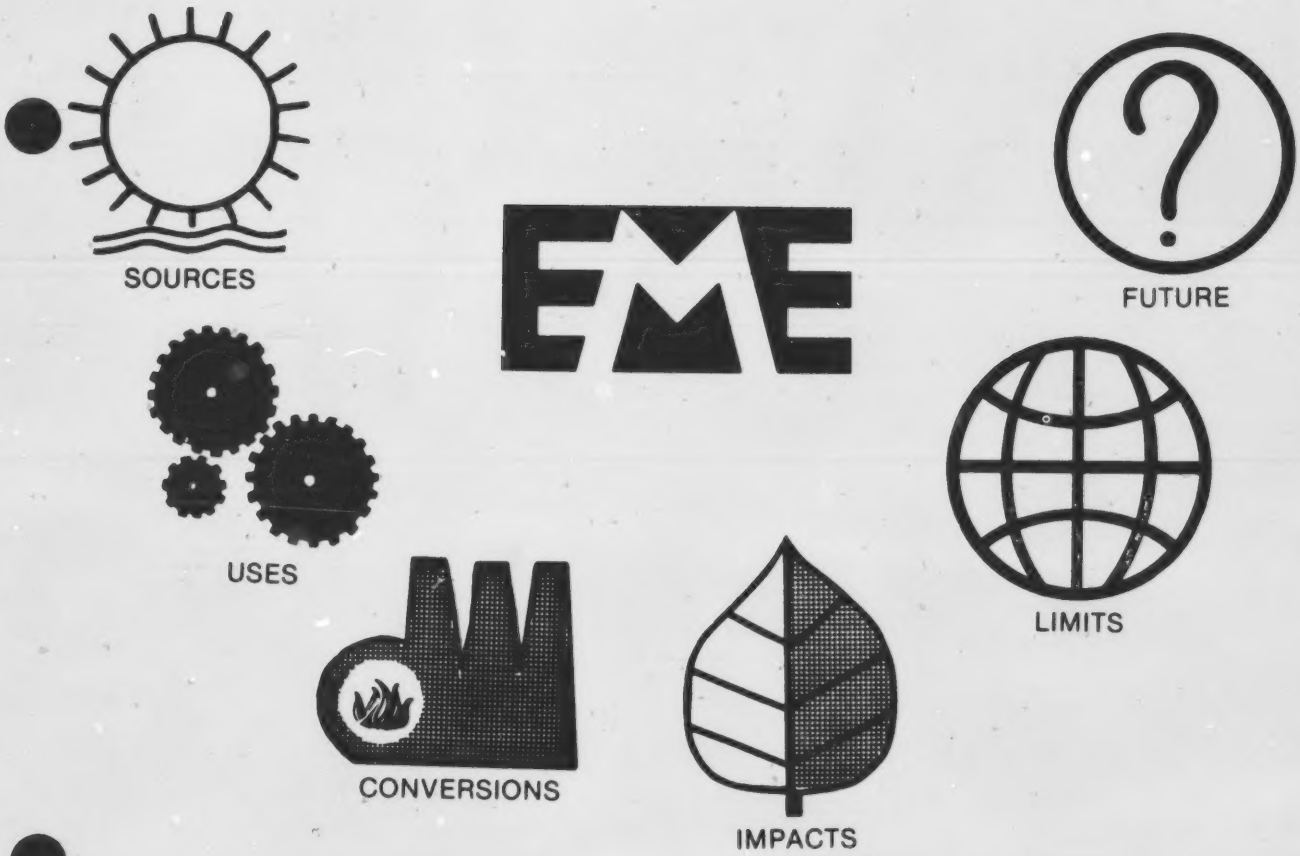
WARNING: SOME OF THE ACTIVITIES IN THIS NOTEBOOK ARE POTENTIALLY HAZARDOUS, DUE TO THE USE OF FLAMMABLE SUBSTANCES AND/OR HEAT. PLEASE EXERCISE EXTREME CAUTION. CHECK YOUR LOCAL AND STATE LAWS GOVERNING THE USE OF FLAMMABLE MATERIALS IN THE CLASSROOM.

ACTIVITY/SUBJECT MATTER MATRIX

ENERGY AND CONSERVATION EDUCATION

Activities for the Classroom

Grades 7-9



INDEX
ACTIVITY/SUBJECT MATTER MATRIX
SOURCES (7-9)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
1	"Wind Power - How Good Is It?"	7-9	Var.		X							X		
2	"Energy Used In Providing Food"	9-10	2-3		X	X				X		X		
3	"Using A Magnifying Glass"	7-9	1-2		X	X						X		
4	"How Does It Happen In Your Town?"	8-9	Var.			X	X					X		
5	"Energy Used In Providing Shelter"	9-10	Var.		X	X	X					X		
6	"Which Fuel?"	8-9	Var.			X	X	X				X		
7	"Energy Used In Providing Clothing"	9-10	3-4			X	X				X	X		

Var. = Variable

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ACTIVITY/SUBJECT MATTER MATRIX
USES (7-9)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS												
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art	Personal Finance
1	"Meter Readers All"	7-9	Var.		X	X				X		X			X
2	"Population vs. Food: An Energy Problem"	8-10	4-5		X	X						X	X		
3	"Energy Crossword Puzzles"	7-8	1-2	X	X	X	X	X	X	X	X	X	X	X	
4	"Energy Consumption"	7-9	2	X	X	X						X			
5	"Water As An Energy Source"	9-10	Var.		X							X			
6	"There's More Than Gas In A 'Cycle"	7-9	1-2	X	X	X	X	X	X	X	X	X	X	X	
7	"Eating Energy"	7-9	1-2		X	X				X		X			

Var. = Variable

INDEX
ACTIVITY/SUBJECT MATTER MATRIX
USES (7-9) (continued)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS											
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art	
8	"Who Gets What?"	7-9	2-3			X	X					X			
9	"Identifying Poor Energy Uses"	7-9	1-2		X	X	X					X			
10	"Who Needs An Electric Tooth-Brush"	7-9	1-2		X					X		X	X		
11	"Energy Conservation In The Home"	7-9	Var.		X		X			X		X			
12	"How Much Electricity Do You Use?"	7-9	1-2	X	X	X						X			
13	"Things I Like To Do"	7-9	Var.			X						X			
14	"Our Leisure Time Activities"	7-9	Var.			X						X			

Var. = Variable

INDEX
ACTIVITY/SUBJECT MATTER MATRIX
CONVERSION (7-9)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
1	"A Radiometer Experiment"	7-8	1-2		X							X		
2	"Making 'Blueprints'"	7-8	2-3		X							X		X
3	"Evaporation - Condensation"	8-9	1		X	X						X		
4	"Energy And A Physical Change Of State"	8-9	1		X							X		
5	"Liberation Of Heat Energy"	8-9	1		X							X		
6	"The Conversion Process"	8-9	2		X							X		
7	"Fuel Sources"	8-9	1		X	X						X		

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ACTIVITY/SUBJECT MATTER MATRIX

CONVERSION (7-9) (continued)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
8	"Careers In Nuclear Science"	7-9	Var.			X	X					X		

Var. = Variable

INDEX
ACTIVITY/SUBJECT MATTER MATRIX
IMPACTS (7-9)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
1	"A Choice Of Home Heating Sources"	8-9	3-4			X	X			X		X		
2	"Selection Of A Power Plant Site"	7-9	Var.	X	X	X	X	X	X	X	X	X	X	X
3	"Future Nuclear Plant Sites"	8-10	3-4	X	X	X	X	X	X	X	X	X	X	X
4	"'Unwise' Energy Use"	9-10	4-5			X	X	X				X		
5	"Lifestyle Choices And Energy Use"	9-10	3	X	X	X	X	X	X	X	X	X	X	X
6	"Zoning And Energy Requirements"	7-8	Var			X						X		
7	"Traditional Values And Energy-Use Problem Solving"	8-10	3-4			X	X					X		

Var. = Variable

INDEX
ACTIVITY/SUBJECT MATTER MATRIX

IMPACTS (7-9) (continued)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
8	"What's In The Air? Who Put It There?"	7-9	4-5			X	X					X		
9	"Then And Now"	7-9	2-3			X	X					X		
10	"A Land Use Attitude Survey"	8-9	7-8		X	X	X					X		

INDEX
ACTIVITY/SUBJECT MATTER MATRIX
LIMITS (7-9)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
1	"Depleting Energy Sources"	7-9	1	X	X	X	X	X	X	X	X	X	X	X
2	"A Trip To 'New Earth'"	8-9	5-7	X	X	X	X	X	X	X	X	X	X	X
3	"Conserving Natural Resources"	9-10	3-4			X					X	X		
4	"Energy Demands And Fossil Fuels"	8-10	1-2	X	X	X						X		
5	"The Energy Dilemma"	7-9	Var.	X	X	X	X	X	X	X	X	X	X	X
6	"We're Out Of Oil?"	8-9	3-4		X	X						X		
7	"People And Energy"	7-9	1-2	X		X						X		

Var. = Variable

INDEX
ACTIVITY/SUBJECT MATTER MATRIX
FUTURE (7-9)

Activity #	Activity Title	Grade Level	Time In 45 Min. Class Prds.	SUBJECT MATTER AREAS										
				Math	Science	Soc.Sci.	Language Arts	Speech	Industr. Arts	Home Ec.	Consumer Ed.	Career Ed.	Health	Art
1	"Solar Radiation?"	7-9	1-3	X	X	X	X	X	X	X	X	X	X	X
2	"Nuclear Reactors- A New Language"	7-9	2		X							X		
3	"Nuclear Plants"	8-10	1	X	X	X	X	X	X	X	X	X	X	X
4	"Dispose or Recycle?"	7-9	4-5	X	X	X	X	X	X	X	X	X	X	X
5	"Power Consumption At Home"	7-9	Var.	X	X							X		
6	"A Change In Vacation Plans"	7-9	3-4			X	X					X		
7	"Jobs In The Future"	7-9	3-4	X	X	X	X	X	X	X	X	X	X	X

Var. = Variable

SOURCES OF ENERGY

GOAL:

IT IS ESSENTIAL THAT EACH PERSON KNOW THAT THERE ARE MANY SOURCES OF ENERGY.

ACTIVITY
DESCRIPTION PAGE
SOURCES (7-9)

Goal: It is essential that each person know that there are many sources of energy.

Concept: Energy is the capacity to do work and is subject to natural laws.

Activity #1 "Wind Power - How Good Is It?"
Grade level 7-9
Science

Given the opportunity to construct a working model windmill, the student will be able to demonstrate and evaluate problems related to the energy output of a small windmill.

Activity #2 "Energy Used In Producing Food"
Grade level 9-10
Home Economics, Social Science, Science

Given the opportunity to list common consumer foods, the student will be able to identify the sources of energy used in providing food.

Concept: Most specific forms of energy originated with the sun.

Activity #3 "Using A Magnifying Glass"
Grade level 7-9
Science, Social Science

Given the opportunity to conduct an experiment, the student will be able to demonstrate how the sun's energy can be gathered, and understand the implications for energy production.

Activity #4 "How Does It Happen In Your Town?"
Grade level 8-9
Language Arts, Social Science

Given the opportunity to conduct a written investigation, the student will be aware that energy is a universal problem.

Concept: High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

Activity #5 "Energy Used In Providing Shelter"
Grade level 9-10
Social Science, Language Arts, Science

Given the opportunity to list materials used in home construction, the student will be able to identify the sources of energy used in providing shelter and identify means to conserve these energy sources.

Activity #6 "Which Fuel?"
Grade level 8-9
Social Science, Language Arts, Science

Given the opportunity to select a "perfect" fuel, the student will be able to evaluate a fuel as a source of energy, emphasizing considerations of supply, distribution, efficiency, and environmental impact.

Concept: Exploitation of different energy sources results in a variety of occupations.

Activity #7 "Energy Used In Providing Clothing"
Grade level 9-10
Social Science, Career Education, Language Arts

Given the opportunity to list articles of clothing, the student will be able to identify the sources of energy used in providing clothing.

BATTERY OPERATED
GENERATOR OPERATED

title: "Wind Power - How Good Is It?"

sources

concept: Energy is the capacity to do work and is subject to natural laws.

objective: Given the opportunity to construct a working model windmill, the student will be able to demonstrate and evaluate problems related to the energy output of a small windmill.

time: Variable

subject matter area: Science

grade: 7-9

implementation:

Activity:

1. Wind power, how good is it?
2. Build a small windmill using a kit from a supply house (or see activity and directions for grade 5, written by Shirley Barnes).
3. Take the windmill outside each day for one week. Check the number of times it will lift one sinker in five minutes, from the base of the windmill to the height of the wheel axle where the string is fastened.
   a. Will it lift two sinkers?
   b. Will it lift more than two?
4. Does your investigation prove that windmills are a dependable source of power in your community? Why?
5. Where in your region would wind power most likely be a dependable source of power?
6. List as many reasons as you can:
   a. Why wind may be a desirable source of energy.
   b. Why problems may be associated with wind power.

materials:

Windmill kit such as the 17 inch size offered by Edmund Scientific Company.

Sinkers

activity no. 1

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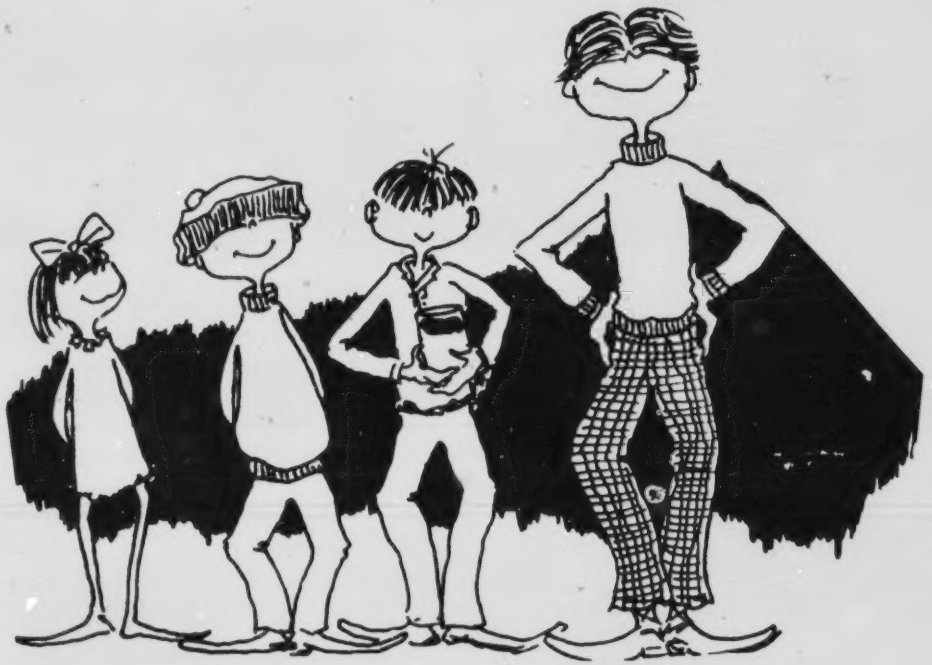
implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to research new sources of power, the student will be able to identify at least ten new occupations associated with each new power source.



materials:

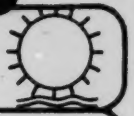
SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to build and carry out experiments with a small windmill, the student will be able to list reasons for the desirability of wind as a source of energy and problems that may be associated with wind power.

Developed by: Mabel M. Lund
Beaverton School District
Beaverton, OR

title: "Energy Used In Providing Food"

sources



concept: Energy is the capacity to do work and is subject to natural laws.

objective: Given the opportunity to list common foods, the student will be able to identify the sources of energy used in providing food.

time: 2-3 45 minute class periods

subject matter area: Home Economics, Science, Social Science

grade: 9-10

implementation:

Activity:

1. List all the different foods including snacks, drinks, etc., consumed in two average days.

2. Under each food, list the sources of energy required in producing it. In some instances this will necessitate also listing the products involved in the preparation of the food, i.e., flour, yeast, shortening, sugar, etc. List the source of energy by each item. State whether the sources are renewable or nonrenewable.

3. Considerable energy was drawn from sources in making it possible for the food to be prepared. Machines, equipment, transportation, processing plants, etc., are all involved in processing the food you consume. List as many of these as you can. Identify the sources of the energy they required. State whether the sources are renewable or nonrenewable.

   a. You can conclude from your research that there is an extreme drain on energy sources in supplying our nation with food.

materials:

activity no. 2

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implementation:

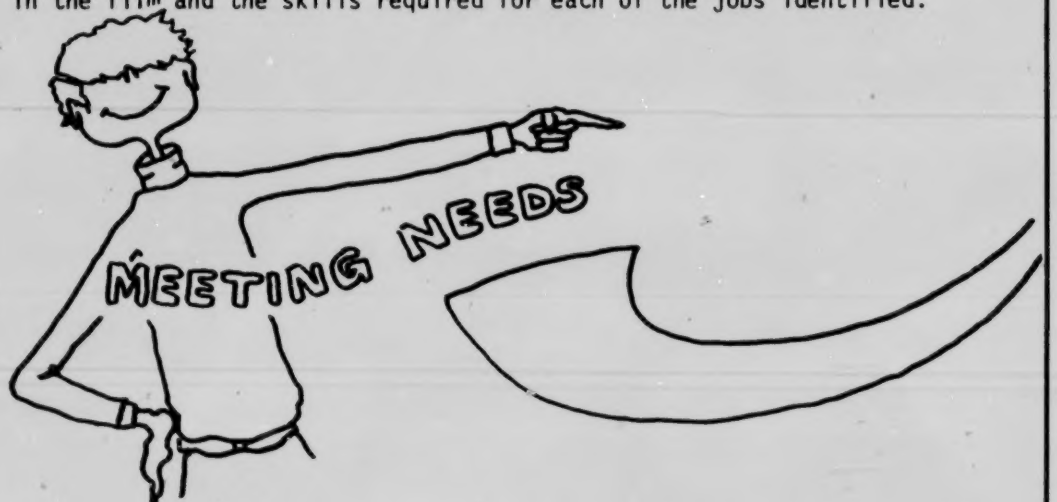
Activities: (continued)

4. Write as many suggestions as you can for conserving energy demands, yet meeting needs adequately. (Please note the word adequately does not mean an unnecessary surplus or a luxury standard.)

5. Choose a different but comparable set of intial objects for the investigation.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to view a film on the manufacturing process of an individual food item, the student will be able to identify the job shown in the film and the skills required for each of the jobs identified.



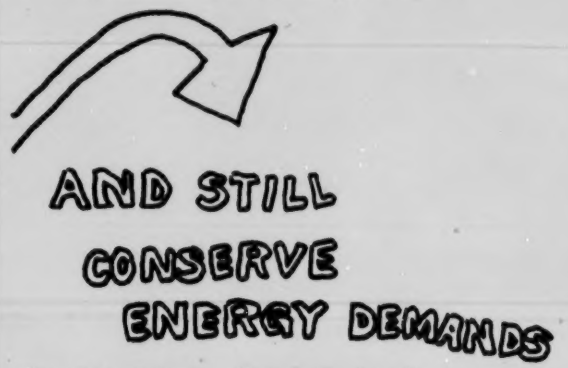
materials:

SUGGESTED ASSESSMENT PROCEDURE:

Ask the student to:
Enumerate sources of energy used in providing daily essential needs.

Suggest means to conserve those sources in relation to meeting the daily essential needs.

Given the opportunity to identify and list the sources of energy used in providing daily essential needs, the student will be able to suggest means to conserve the sources of energy.



Developed by: Mabel M. Lund
Beaverton School District
Beaverton, OR

title: "Using A Magnifying Glass"

sources

concept: Most specific forms of energy originated with the sun.

objective: Given the opportunity to conduct an experiment, the student will be able to demonstrate how the sun's energy can be gathered and understand the implications for energy production.

time: 1-2 45 minute class periods

subject matter area: Science, Social Science

grade: 7-9

implementation:

Activity:

1. Pass out magnifying glasses (one to every two students).
2. Pass out a sheet of newspaper.
3. Instruct students to crumple up the newspaper.
4. Take newspaper and the magnifying glass to an area where there is bright sunshine. (Outside on an asphalt or concrete walkway, etc.)
5. Place the magnifying glass above the newspaper and raise and lower the magnifying glass until the bright light is concentrated in as small an area as possible.
6. Hold magnifying glass in that position until paper begins to smoke. (If fire starts, put it out immediately.)
7. Have students discuss the implications of the experiment - as it relates to energy.

materials:

Magnifying glasses
Newspaper

activity no. 3

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implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to explore information on solar energy, the student will be able to determine the potential for employment in an area of interest in the solar energy field.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to complete an experiment in collecting the sun's energy, the student will be able to participate in a class discussion on the implications of the experiment to the production of energy.

Developed by: Tom Schultz
Seattle, WA

Revised by: Duane K. Altig

title: "How Does It Happen In Your Town?"

sources

concept: Energy resources are unevenly distributed around the earth.

objective: Given the opportunity to conduct a written investigation, the student will be aware that energy is a universal problem.

time: Variable

subject matter area: Social Science, Language Arts

grade: 8-9

implementation:

Activity:

1. Group activity for four or more students, this activity could also be related to Language Arts communication skill.

2. A group of four or more students will write for information regarding the sources of energy in specific areas of different states. Names of junior high students may be known through existing contacts. (Be sure to include a stamped, self-addressed envelope.) Each student will select to whom he/she will write. Information requests will include:
   a. _____ is/are sources of energy used by industry in the area.
   b. _____ is the chief source of energy used by industry in the area.
   c. _____ is used for generating electricity in the area.
   d. _____ is the energy used by most homes for heating, _____, _____, are also used.
   e. Describe the public forms of transportation in the area.
   f. Is the public transportation system being used by more people than two years ago? Why?

materials:

activity no. 4

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implementation:

Activities: (continued)

g. Is there successful organized effort in improving the environmental impact by people? Describe some of these projects.

3. Be sure to express appreciation by mail to those responding to the requests.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to contact persons from a variety of areas in the United States, the student will be able to discover the difference in employment opportunities which might occur in specific occupations of interest to the student.

materials:

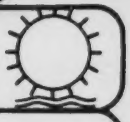
SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to contact persons in other states, the student will be able to understand that energy is a universal problem.

Developed by: Mabel M. Lund
Beaverton School District
Beaverton, OR

title: "Energy Used In Providing Shelter"

sources



concept: High grade (concentrated) energy sources occur in relatively small amounts and take relatively smaller amounts of "outside" energy to find and recover.

objective: Given the opportunity to list the materials used in home construction, the student will be able to identify the sources of energy used in providing shelter, and identify means to conserve these energy sources.

time: Variable

subject matter area: Social Studies, Science, Language Arts

grade: 9-10

implementation:

Activity:

1. This activity may be done individually or in small groups.
2. Visit a new house that is for sale observing carefully the inside and the outside. Make a list of as many materials as you can that were utilized in the construction of the home.
3. Take the list and item by item enumerate all the steps through which each material was processed in becoming the final product. Also, list the steps involved in transporting the products to their destination. With each item, state the source or sources of the energy utilized. State whether it is renewable or nonrenewable.
4. Now review your entire investigation. List any suggestions you have for providing adequate shelter for our nation while at the same time reducing the use of energy sources.

materials:

activity no. 5

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implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to complete the activity "Energy used in providing shelter," the student will be able to list ten occupations of interest to research in the Dictionary of Occupational Titles and the Occupational Outlook Handbook.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to build an energy ladder for the materials used in the construction of a new home, the student will be able to enumerate the sources of energy used, and the means to conserve the energy sources in relation to meeting the daily essential needs.

Developed by: Mabel M. Lund
Beaverton School District
Beaverton, OR

Revised by: Duane K. Altig

title: "Which Fuel?"

sources

concept: High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy.

objective: Given the opportunity to select a "perfect" fuel, the student will be able to evaluate a fuel as a source of energy emphasizing considerations of supply, distribution, efficiency and environmental impact.

time: Variable

subject matter area: Social Science, Language Arts, Speech

grade: 8-9

implementation:

Activity:

1. Which Fuel?

2. Assume a perfect fuel would .....
   a. be unlimited in supply.
   b. be equally distributed throughout the world.
   c. present no technological problems.
   d. have no adverse impact on the environment.

3. The student will select the fuel he feels is the most nearly perfect and defend his choice. (Through research and in writing.)

4. This may be used as a debate if two students feel a desire to do so.

5. If groups of students select the same fuel they may wish to present their information as a panel.

materials:

activity no. 6

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implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to view a sound filmstrip on ecological problems, the student will be able to appraise the impact of technological changes on the job market.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given an opportunity to select a fuel considered to be most perfect, the student will be able to evaluate the selected fuel as a source of energy emphasizing considerations of supply, distribution, efficiency, and environmental impact.

Developed by: Mabel M. Lund
Beaverton School District
Beaverton, OR

Revised by: Duane K. Altig

title: "Energy Used In Providing Clothing"

sources

concept: Exploitation of different energy sources results in a variety of occupations.

objective: Given the opportunity to list articles of clothing, the student will be able to identify the sources of energy used in providing clothing.

time: 3-4 45 minute class periods

subject matter area: Social Studies, Language Arts, Career Education

grade: 9-10

implementation:

Activity:

1. List all the garments you wear in 24 hours; these would include shoes, hats, hosiery, swimsuits, etc. Under each garment list all the materials used in making it and the content of the material, i.e., cotton, wool, nylon, polyester, vinyl, leather, metal, etc. With each item identify the sources of energy used in its development.

2. Nothing is manufactured or produced without drawing from sources of energy for the processes involved. Identify all the materials used in making possible the processes for producing your garments. In preparing the list also include transportation needs. With each item include those sources of energy required to produce it and state whether the source is renewable or nonrenewable.

3. As you compile all the information, think of ways people can reduce the demands on the energy sources.
   a. Develop as many ideas as you can, permitting the people of our society to be properly and adequately clothed, yet reducing the energy consumption more than 25%.

materials:

activity no. 7

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implementation:

Activities: (continued)

4. Have each student choose one of the initial objects listed and trace all of the occupations involved in its production, from the source to the finished product.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to hear a speaker on the topic of job interviews, the student will become aware of the significance of grooming in the process of job seeking.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Have the student:

Enumerate sources of energy used in providing daily essential needs.

Suggest means to conserve those sources in relation to meeting daily essential needs.

Given the opportunity to list a variety of garments worn in a 24 hour period and identify the energy sources used in producing the garments, the student will be able to select one garment and trace all the occupations involved in its production.

Developed by: Mabel M. Lund
Beaverton School District
Beaverton, OR

USES OF ENERGY

GOAL:

IT IS ESSENTIAL THAT EACH PERSON KNOW THAT PEOPLE ARE DEPENDENT UPON ENERGY.

ACTIVITY
DESCRIPTION PAGE

USES (7-9)

Goal: It is essential that each person know that people are dependent upon energy.

Concept: All living things and natural processes require energy.

Activity#1 "Meter Readers All"
Grade level 7-9
Science, Social Science, Home Economics

Given the opportunity to complete worksheets on electricity meter reading, the student will be able to relate reading of electricity meters to the consumption of energy for a household.

Activity #2 "Population vs. Food: An Energy Problem"
Grade level 8-10
Social Science, Health, Science

Given the opportunity to participate in classroom tasks, the student will be able to describe at least five causes of inadequate nutritious food supplies for the world's population.

Concept: Each form of energy can be used in many ways.

Activity #3 "Energy Crossword Puzzles"
Grade level 7-8
All Subject Matter Areas

Given the opportunity to study terms related to energy forms, the student will be able to correctly complete a crossword puzzle and construct a crossword puzzle using energy related terms.

Activity #4 "Energy Consumption"
Grade level 7-9
Science, Mathematics, Social Science

Given the opportunity to complete problems from an energy consumption table, the student will be able to identify a variety of different uses for one type of energy.

Activity #5 "Water As An Energy Source"
Grade level 9-10
Science

Given the opportunity to understand the process of electrolysis, the student will be able to learn about the chemical composition of water and the use of water as an energy source.

Concept: Some human technologies and activities use more energy than others.

Activity #6 "There's More Than Gas In A 'Cycle"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to examine a motorcycle, the student will be able to identify energy consumption other than home operational needs, transportation, and public heating.

Activity #7 "Eating Energy"
Grade level 7-9
(Home Economics, Social Science, Science)

Given the opportunity to discuss "There is no such thing as a free lunch," the student will be able to identify the flow of energy uses in providing food for our society.

Concept: Every decision made involving energy affects standards of living.

Activity #8 "Who Gets What"
Grade level 7-9
(Social Science, Language Arts)

Given the opportunity to evaluate a large scale energy disaster, the student will be able to consider priorities for energy consumption.

Concept: There are many ways to conserve energy.

Activity #9 "Identifying Poor Energy Uses"
Grade level 7-9
(Social Science, Science, Language Arts)

Given the opportunity to survey a shopping center, the student will be able to identify lack of conservation in the use of energy in community life.

Activity #10 "Who Needs An Electric Toothbrush?"
Grade level 7-9
(Health, Home Economics, Science)

Given an opportunity to purchase a toothbrush, the student will be aware that more energy is involved in an electric toothbrush than the power to turn the motor.

Activity #11 "Energy Conservation In The Home"
Grade level 7-9
(Language Arts, Home Economics, Science)

Given the opportunity to identify and appraise the use of home appliances, the student will be able to identify most kinds of home appliances, their frequency of use and those most necessary to meet the daily needs of a home.

Activity #12 "How Much Energy Do You Use?"
Grade level 7-9
(Mathematics, Social Science, Science)

Given the opportunity to answer the question "How much energy do you use?" the student will be able to know the differences in amounts of electricity used by various appliances.

Activity #13 "Things I Like To Do"
Grade level 7-9
Social Studies (values)

Given the opportunity to make a list of things they like to do, the students will be able to examine the items and determine a value for each.

Activity #14 "Our Leisure Time Activities"
Grade level 7-9
Social studies (values)

Given the opportunity to participate in a values clarification exercise, the student will be able to become more aware of the relationship between standard of living and energy use.

title: "Meter Readers All"

uses

concept: All living things and natural processes require energy.

objective: Given the opportunity to complete worksheets on electricity meter reading, the student will be able to relate reading of electricity meters to the consumption of energy for a household.

time: Variable

subject matter area: Home Economics, Personal Finance, Social Science, Science

grade: 7-9

implementation:

Activity:

1. Discuss the need for energy by people at home (lead discussion to the measurement of energy use).
2. Hand out worksheet #1 and allow students time to complete the exercises. (Correct and discuss in class.)
3. Have students read and record their home electricity meters for a period of time (one week, two weeks, one month).
4. Hand out worksheet #2 and have students complete the exercises. (Correct and discuss in class.)

   *Optional For Lower Grade Levels-could be demonstrated by the teacher.
5. Students can figure the costs of electricity for their own home and compare it to the national average electricity costs.
6. Students can discuss the implications of energy costs to present and future supplies and uses of energy for the household.

materials:

Dittoed copies of "How to Read Your Meter"
Math problems - attached (if used)
Large demonstration meter (if used)

activity no. 1

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implementation:

Activities:
(continued)

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify the costs of household energy use, the student will be able to participate in a classroom discussion about the implication of energy costs and uses to the quality of life relative to the future role of the student as an income earner.

materials:

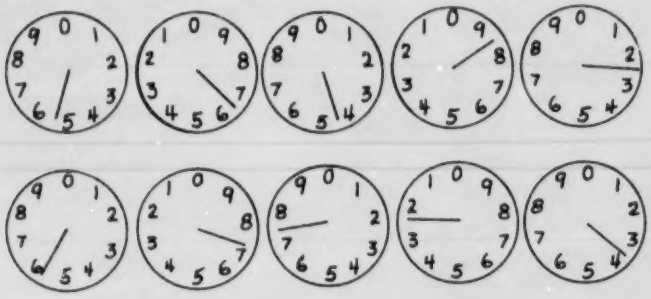
SUGGESTED ASSESSMENT PROCEDURE:

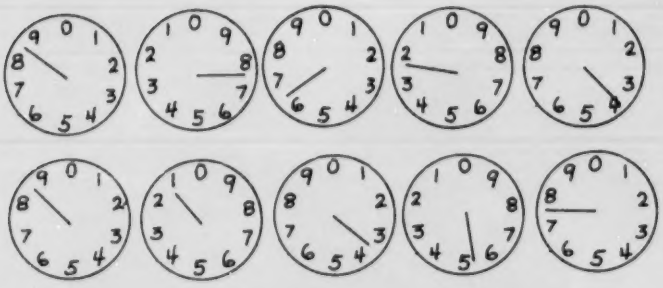
Given the opportunity to read electricity meters, the student will be able to, through class room discussion, relate the reading of electricity meters to the use of energy by individual households.

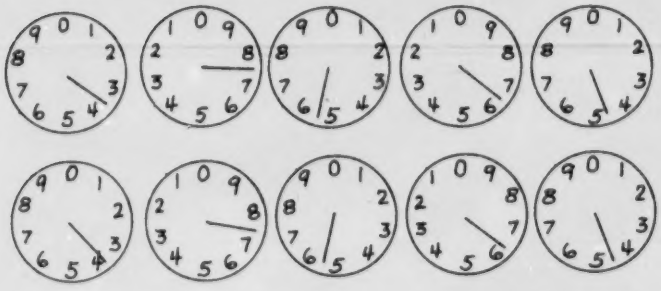
Developed by: Joanne Martina
Everett School District
Everett, WA

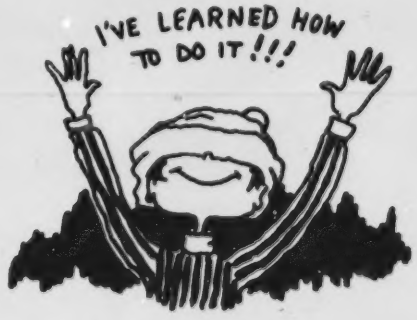
Revised by: Duane K. Altig

Read these meters, subtract and figure the cost of electricity at .78 cents per kilowatt hour (x $.0078) for Washington County and at 2.36 cents per kilowatt hour (x $.0236 for the national average.

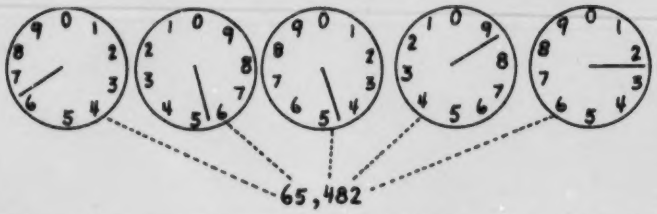








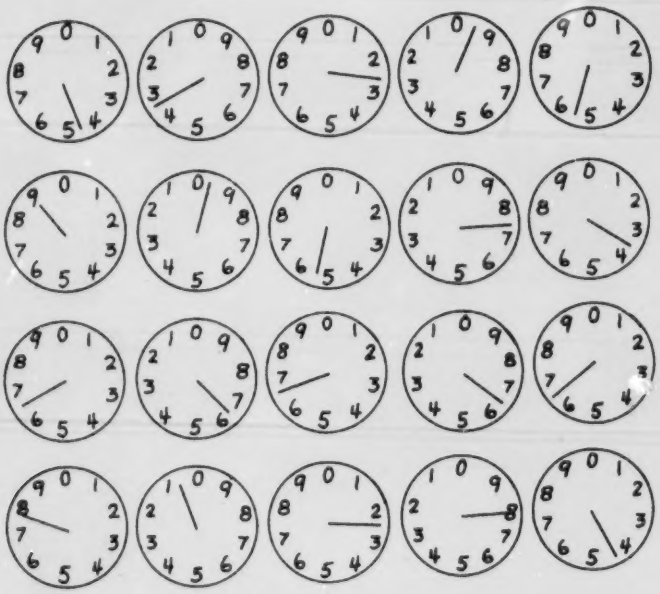
HOW TO READ YOUR METER



Your electric meter is a precise, additive device which directly records the units of electricity (Kilowatt hours) used in your home. Each meter dial records one-tenth of the dial on its left - units, tens, hundred, thousands, and ten-thousands.

As an example, the above dial read 65,482. An electric bill would be determined by subtracting the previous reading from this reading to find the total kilowatt hours consumed between reading dates. To read a meter, start with the right hand dial and read left. The pointers on the first, third, and fifth dials move clockwise and the second and fourth move counterclockwise. If the pointer is directly on a number, read the next smaller number unless the pointer on the dial at its right has passed zero.

Read the meters:



title: "Population vs. Food: An Energy Problem"

uses

concept: All living things and natural processes require energy.

objective: Given the opportunity to participate in classroom tasks, the students will be able to describe at least five causes of inadequate nutritious food supplies for the world's population.

time: 4-5 45 minute class periods

subject matter area: Health, Science, Social Science

grade: 8-10

implementation:

Activity:

1. Give an essay-type of pre-test to assess students' knowledge of the existing problem of world food supply.
2. Record on a blackboard a tally of the class' perceptions of a proposed problem.
3. Discuss the problem informally in class.
4. Use available reference material to investigate the problem by finding out where most of the world's food is produced. Use maps to pinpoint areas.
5. On a map, mark the major per capita consumers of the world's food.
6. Have the class discuss the differences between the two maps.
7. Identify which one food nutrient is, or should be, in greatest demand yet is obviously in shortest supply worldwide.

materials:

Reference books
Charts
Maps
Paper
Art supplies
Science equipment

equipment:

16mm projector
Slide projector
Overhead projector
Tape recorder
Film strip projector
8mm film loops
Listening posts
Earphones

activity no. 2

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implementation:

Activities: (continued)

8. Research and list all sources of animal and plant protein. Find out how much the average person needs each day to stay healthy. What is the estimated protein intake for most of the world's population?
9. List what happens to the body when deprived of minimum protein requirement.
10. Using movies, filmstrips, slides, books, videotapes, and tape recordings, look for apparent causes of inadequate food supplies. Record these. Many have been identified by scientists and organizations such as the Food and Agriculture Organization and the World Health Organization.
11. Have students cite reasons for their agreement or disagreement with these causes.
12. Construct prototypes, collect examples through pictures, or perform experiments to illustrate one of the reasons, (i.e., erosion, widespread use of pesticides, pollution) relating to food production.
13. Invite resource people to discuss the causes with the class.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given an opportunity to identify one of the causes of inadequate food supply, the student will be able to suggest a possible solution to the problem and identify present, and/or, future types of occupations which would be involved in solving the problem.

materials:

(continued)

INFORMATION SOURCES

Contact State and Federal Departments of Agriculture.

Food & Agriculture Organization
of the United Nations
1776 F Street, N.W.
Washington, DC 20437

Film: "Food Supply: Its Effect On Civilization"
Produced by Journal Films.
Rentals often available from nearest university film library.

Energy, Food and You is an excellent curriculum guide on this subject. Contact
Shoreline School District
NE 158th and 20th Avenue NE
Olympia, WA 98504

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to participate in a variety of classroom activities, the student will be able to identify five causes of inadequate nutritious food supplies for the world's population.

Developed by: Rita Paxton
Whittier Elementary Sch.
Salt Lake City, UT

Revised by: Duane K. Altig

title: "Energy Crossword Puzzles"

uses

concept: Each form of energy can be used in many ways.

objective: Given the opportunity to study terms related to energy forms, the student will be able to correctly complete a crossword puzzle, and construct a crossword puzzle using energy related terms.

time: 1-2 45 minute class periods

subject matter area: All

grade: 7-8

implementation:

1. The crossword puzzle was designed to be used following any discussion involving energy or alone as a challenge or enrichment activity in science. The words used are listed at the bottom of the sheet and can be detached or left on as needed by the particular student.

materials:

Ditto copies of crossword puzzle.

activity no. 3

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implementation:

(continued)

2. Have students construct an energy crossword puzzle of their own. (You might wish to have students exchange their puzzles.)

SUGGESTED CAREER EDUCATION ACTIVITY: None

materials:

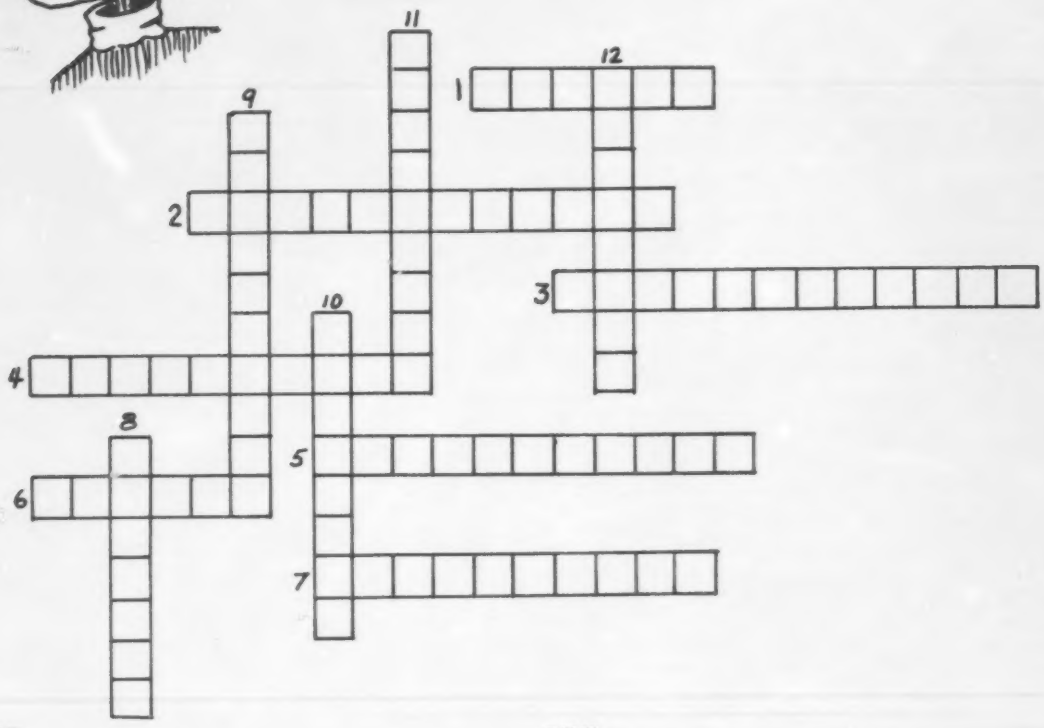
SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to become familiar with energy related terms, the student will be able to complete and construct an energy crossword puzzle.

Developed by: Joanne Martina
Everett School District
Everett, WA

Revised by: Duane K. Altig

ENERGY CROSSWORD PUZZLE



ACROSS:

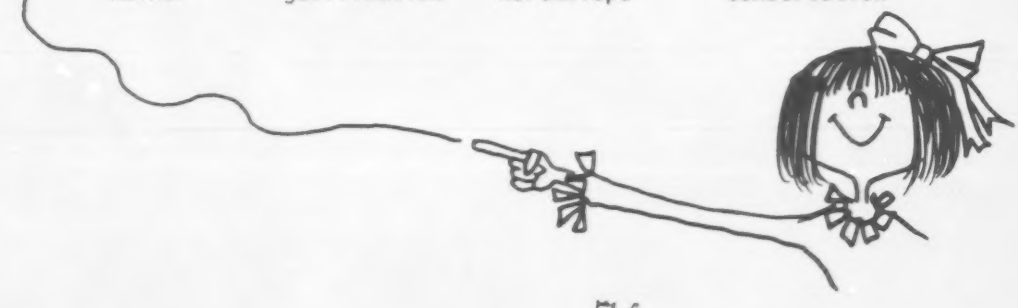
1. Vessel used to transport oil.
2. Wise use of resources.
3. Method of converting coal to another form.
4. Changing from one form to another.
5. Most efficient form of energy.
6. Common measure for oil.
7. Location of Alaskan oil.

DOWN:

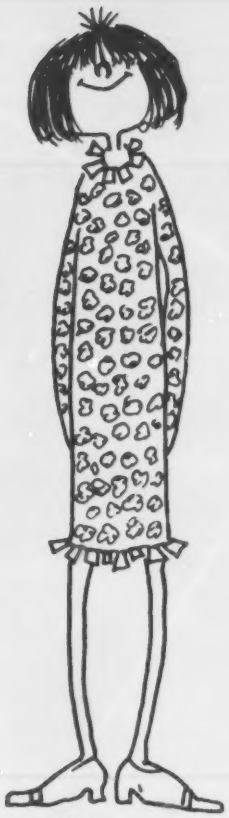
8. Alaskan Bay which oil tankers will use.
9. Energy from heat of the earth.
10. Method of transporting oil.
11. Measure of heat.
12. Measure of electrical energy.

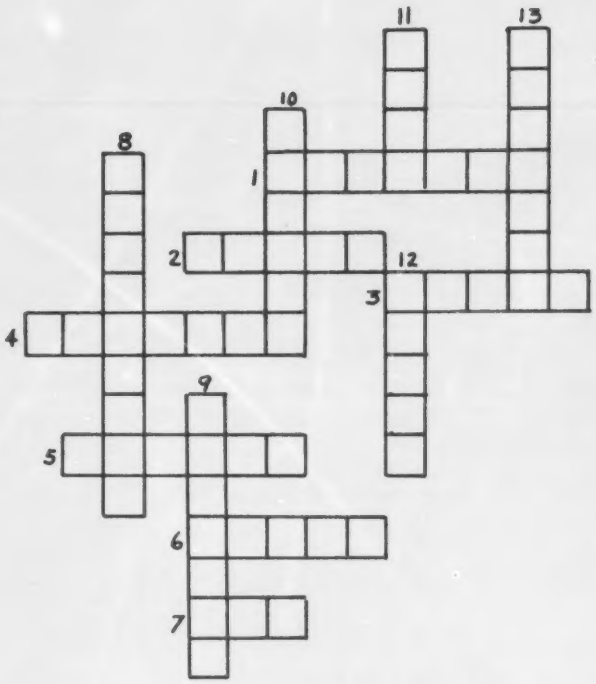
KEY

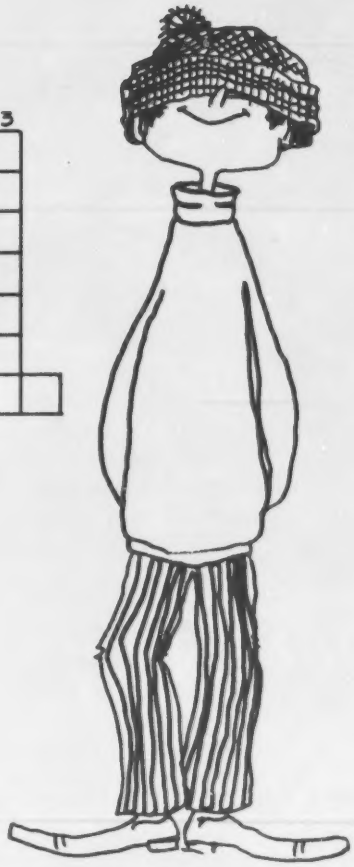
barrel	conversion	geo-thermal	pipeline
calorie	electricity	kilowatt	Prudhoe
tanker	gasification	Northslope	conservation



ENERGY CROSSWORD PUZZLE







ACROSS:

1. Energy produced by radioactive materials.
2. Our planet.
3. Rock formation containing oil.
4. Study of relationship between plant, animals and environment.
5. Process of fuzing atoms
6. Type of mining.
7. Shorter name for petroleum.

DOWN:

8. Present main source of energy in the U.S.
9. Process of splitting atoms.
10. Ability to do work.
11. Fossil fuel.
12. Energy produced by sun.
13. Energy produced by heat.

KEY

coal	energy	nuclear	shale
earth	fission	oil	solar
ecology	fusion	strip	petroleum
thermal			

title: "Energy Consumption"

uses

concept: Each form of energy can be used in many ways.

objective: Given the opportunity to complete problems from an energy consumption table, the students will be able to identify a variety of different uses for one type of energy.

time: 2-45 minute class periods

subject matter area: Science, Mathematics, Social Science

grade: 7-9

implementation:

Activity:

1. The Energy Consumption Table and the problems are distributed to the student.
2. Discuss the items on the energy consumption table as they relate to the students home area.
3. Have students complete the 10 problems.
4. Discuss the answers to the questions.
5. Have students suggest additional questions and discuss the answers in class.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify a variety of different uses of electrical energy, the student will be able to select one use and identify a minimum number (identified by the teacher) of occupations related to the one energy use.

materials:

Ditto copies of the Energy Consumption Table and the 10 questions.

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to complete and discuss a number of questions from an energy consumption table, the student will be able to identify 10 different uses of electrical energy.

Developed by: Joanne Martina
Everett, WA

Revised by: Duane K. Altig

activity no. 4

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ENERGY CONSUMPTION BY HOME APPLIANCES AND LIGHTING

	Annual Energy Consumption (Kilowatt-hours)	Annual Cost of Energy Consumed*
Air Conditioner	2000	$ 47.20
Electric Blanket	150	3.54
Can Opener	0.3	.01
Clock	17	.40
Clothes Dryer	1200	28.32
Coffee Maker	100	2.36
Dishwasher	350	8.26
Fan (Ventilation)	270	6.37
Fan (Furnace)	480	11.33
Fluorescent Light (3 fixtures)	260	6.14
Food Freezer (16 cu. ft.)	1200	28.32
Food Mixer	10	.24
Food Waste Disposer	30	.71
Frying Pan	240	5.66
Hair Dryer	15	.35
Hot Plate (2 burner)	100	2.36
Iron (hand)	150	3.54
Light Bulbs	1870	44.13
Radio (solid state)	20	.47
Radio Phonograph (solid state)	40	.94
Range	1550	36.58
Refrigerator (frost-free - 12 cu. ft.)	750	17.70
Sewing Machine	10	.24
Shaver	0.6	.01
Television (black/white)	400	9.44
Television (color)	540	12.74
Toaster	40	.94
Vacuum Cleaner	45	1.06
Washer (automatic)	100	2.36

* Cost of electricity = $2.36 per kilowatt-hour (national average)
Since cost in Snohomish County is .78 per kwh, divide the cost by three if living in an area with a comparably low cost.

Use the energy consumption table to solve these problems:

1. What is the monthly cost of using a clothes dryer? How many kilowatt hours per month?

2. How many kilowatt hours of energy will be used in a year if a household uses lightbulbs, range, dishwasher, and television?

3. List six appliances used in your home. Show total kilowatt hours of energy consumed and total cost for a year.

4. Which of the appliances listed consumes the most energy? Do you think that this would be a true energy consumption for this part of the country? Why?

5. How many kilowatt hours of energy will be consumed by use of a range?

6. How much would you save in one year if you did not iron your clothes?

7. How much would you save in one year if you did not wash, dry or iron your clothes?

8. List four appliances which would use a total of 2900 kilowatt hours of energy in one year?

9. How much would it cost to use a toaster, vacuum cleaner, coffee maker, can opener, food freezer, food mizer and a food waste disposer for one month? for a year?

10. How much energy would be consumed in one year by a hair dryer, radio, clock and electric blanket?

title: "Water As An Energy Source"

uses

concept: Each form of energy can be used in many ways.

objective: Given the opportunity to understand the process of electrolysis, the student will be able to learn about the chemical composition of water and the use of water as an energy source.

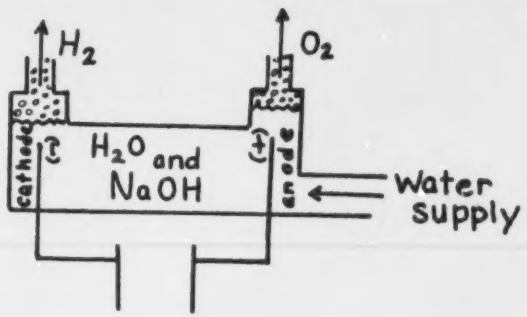
time: Variable

subject matter area: Science

grade: 9-10

implementation:

Activity: 1. Have the students diagram the electrolysis of water.



2. Have the students discuss some of the uses of hydrogen gas.
   a. Means of storing electricity from intermittent sources.
   b. Potential fuel for space heating, industrial processes, and transportation.

materials:

Electrolysis equipment

activity no. 5

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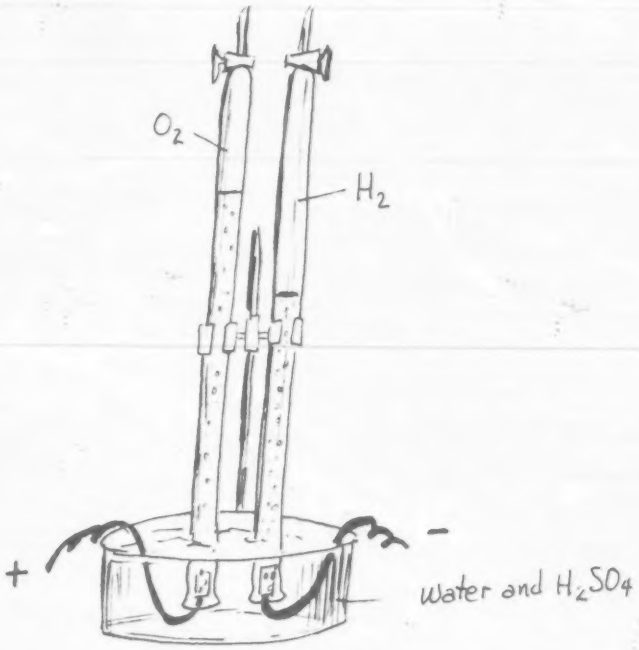
implementation:

Activity: (continued)

3. Advantages of hydrogen fuel in urban areas.
   a. Hydrogen-fueled devices would elimate hydrocarbons, particulates, SO_2, CO_2, NO_x, and CO pollution problems. Water vapor is the only combustion product when hydrogen is burned as a fuel.
   b. Use of oxygen as a valuable by-product from electrolysis.



The Electrolysis of Water

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to discuss the electrolysis of water and the potential use of hydrogen fuel, the student will be able to diagram the electrolysis process and identify several possible uses for hydrogen fuel.

Developed by: Dick Mace
Beaverton School District
Beaverton, OR

title: "There's More Than Gas In A 'Cycle"

uses

concept: Some human technologies and activities use more energy than others.

objective: Given the opportunity to examine a motorcycle, the student will be able to identify energy consumption other than home operational needs, transportation, and public heating.

time: 1-2 45 minute class periods

subject matter area: All

grade: 7-9

implementation:

Activity: 1. Look at a motorcycle or better yet, read an owner's manual that belongs to a 'cycle. Find the following information.

a. How many kinds of material are used in the construction of a motorcycle?
b. Which ones are not renewable?
c. How many metal parts?
d. How many rubber parts?
e. How many plastic parts?
f. How many glass parts?
g. How many other parts?
h. How many of these materials cannot be recycled?
i. Describe as many ways as you can that energy was used in manufacturing the 'cycle.

ANSWER "a" THROUGH "i"

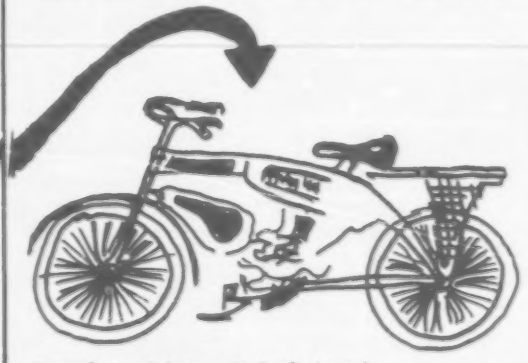
SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify occupations related to the manufacture of a motorcycle, the student will be able to select one of the occupations and relate the education and training necessary for selected occupation.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to identify the materials used in the construction of a motorcycle, the student will be able to describe the energy used in the manufacture of the 'cycle.



Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

activity no. 6

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title: "Eating Energy"

uses

concept: Some human technologies and activities use more energy than others.

objective: Given the opportunity to discuss, "There is no such thing as a free lunch," the student will be able to identify the flow of energy uses in providing food for our society.

time: 1-2 45 minute class periods

subject matter area: Home Economics, Science
Social Science

grade: 7-9

implementation:

Activity:

1. Discuss the statement, "There is no such thing as a free lunch." Do not communicate in dollar and cent values but in terms of energy used to provide the end product of various food items (not less than five different ones).
   a. Resources - References in Reader's Guide under topics;
      - Agriculture
      - Food production
      - Transportation of food commodities
      - Food processing
      - Marketing

2. Note to the teacher: The purpose of this activity is to develop an awareness of the many sources and forms of energy involved in the preparation of a meal.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify the variety of activities related to the production of food items for consumption, the student will be able to recognize the variety of occupations related to food production.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to discuss "There is no such thing as a free lunch," the student will be able to identify the energy used in the production of one food item.

Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

activity no. 7

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title: "Who Gets What?"

uses

concept: Every decision made involving energy affects standards of living.

objective: Given the opportunity to evaluate a large scale energy disaster, the students will be able to consider priorities for energy consumption.

time: 2-3 45 minute class periods

subject matter area: Social Science, Language Arts

grade: 7-9

implementation:

Activity:

1. Introduction - The students will consider the choices to be made if a large scale natural disaster were to strike the United States, severely impairing electric power sources.

2. Divide the class into small groups representing various groups such as:
   a. City government
   b. Factory workers
   c. Consumers
   d. Service Industries
   e. School employees
   f. Others

3. After each group has met and listed their energy needs and priorities in written form, assemble the entire class again.
   a. Have a representative from each group report on his group's decisions for the community.
   b. Have the class as a whole determine their priorities for the entire community as to who will get the available power and to what degree.

materials:

activity no. 8

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implementation:

Activities:
(continued)

Optional Activity: Bring the problem of shortages from part 2 down to personal situations. Ask the students how they would react in this situation:

a. A recent violent storm has damaged local electrical power sources so that electricity in the area must be rationed in private homes to allow adequate supplies to local hospitals and other users. If you knew that the air conditioner and other appliances continued to be used in your best friend's home how would you react? What would you do about it? What should you do about it?

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to analyse the problems of an energy disaster, the student will be able to identify the implications the disaster would have on occupational roles and standards of living from a teacher-selected list of occupations.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to participate in a classroom assigned problem activity, the student will be able to appraise the priorities of energy consumption.

Developed by: Merodee L. Smith
Beaverton School District
Beaverton, OR

Revised by: Duane K. Altig

title: "Identifying Poor Energy Uses"

uses

concept: There are many ways to conserve energy.

objective: Given the opportunity to survey a shopping center, the student will be able to identify lack of conservation in the use of energy in community life.

time: 1-2 45 minute class periods

subject matter area: Social Science, Language Arts, Science

grade: 7-9

implementation:

Activity:

1. Look carefully at a picture of the shopping center plaza, or take a field trip to a local shopping center.
2. Identify all forms of energy being used in buildings and by motors or engines.
3. List any uses where more energy is being used than is needed.
4. Write a plan showing how a committee of local people whose main purpose is to conserve our resources could help reduce the waste or any unnecessary use listed in #3.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given an opportunity to investigate areas of energy conservation, the student will be able to select one area of conservation and identify occupations within that area which are of interest to the student.

materials:

Large picture of a shopping center including commercial buildings, parking areas, and other signs of transportation.

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to survey a shopping center for the identifiable energy uses, the student will be able to identify lack of conservation in the use of energy, and write a plan for effective use of energy resources.

Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

Revised by: Duane K. Altig

activity no. 9

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title: "Who Needs An Electric Toothbrush"

uses

concept: There are many ways to conserve energy.

objective: Given the opportunity to purchase a toothbrush, the student will be aware that more energy is involved in an electric toothbrush than the power to turn the motor.

time: 1-2 45 minute class periods

subject matter area: Health, Home Economics Science

grade: 7-9

implementation:

Activity:

1. You have had some money given to you as a gift. You decide to purchase an electric toothbrush. This may be;
   a. because you saw a sales promotio on TV.
   b. your friend has one.
   c. you want to beat a friend to owning one.

2. Your first effort, perhaps, would be to go to a store that sells them.
   a. Did you walk?
      - If so, how many calories did you use physically?
   b. If you did not walk, what form of energy delivered you to your destination?
      - Was the fuel used to power the transportation the only energy required to get you to your destination? Explain.

3. You have looked at several toothbrush models offered for sale.
   a. How many kinds of material are used in forming the toothbrush?
   b. How many of them are not recoverable?
   c. Was the toothbrush made by hand, simply?
      - If not, what was required to manufacture this electric toothbrush? (Answer this question as completely as you can.)

materials:

Pencils (pens) and paper.

activity no. 10

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implementation:

Activities: (continued)

4. If your grandfather's grandfathers had begun to consume our natural resources with as much speed and as little concern as is frequently done today, what would be left for you and others today?

5. Look at a very efficient, modern, well-designed toothbrush that requires only a little movement from your arm to do an excellent cleaning of your teeth.

6. Answer this last question carefully.

   Who needs an electric toothbrush? (Remember, NEED is not a synonym for WANT in this activity.)

Optional Activity: Two individual students use this activity independently, then compare their answers and make their own changes before the teacher reads them.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to select an item of everyday use by the consumer, the student will be able to construct a collage of pictures depicting the variety of occupations related to the production and use of the selected item.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to answer a series of questions about an electric toothbrush, the student will be able to answer the question, "Who needs an electric toothbrush?"

Developed by: Mabel Lund
Beaverton School District
Beaverton, OR

title: "Energy Conservation In The Home"

uses

concept: There are many ways to conserve energy.

objective: Given the opportunity to identify and appraise the use of home appliances, the student will be able to identify most kinds of home appliances, their frequency of use, and those most necessary to meet the daily needs of a home.

time: Variable

subject matter area: Language Arts, Science, Home Economics

grade: 7-9

implementation:

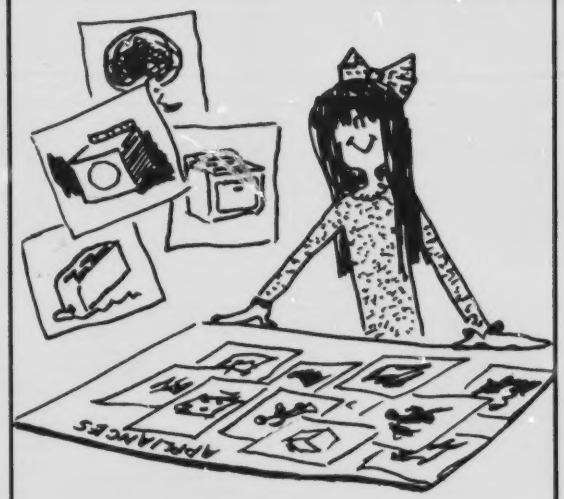
Activity:

1. Collect a set of pictures of home appliances. These may be cut from catalogs, magazine advertisements, etc.

2. Mount them on a large sheet of poster cardboard. You may need more than one. Your teacher may help you in getting these sheets. (If you prefer, you could make a booklet.)

3. As you mount the picture of each appliance, write the following information on a 3" by 5" file card and mount it by or under the picture.
   a. Name of appliance.
   b. Number of times per day it is used (this may be also stated as once in a week, if so, write 1 in 7, etc.)
   c. On the last line, you will give the appliance a rating. For instance, if you have pictures of ten appliances, place a 1 by that appliance you would keep if it were necessary for you to give them all away but one. If you could keep two, which one would you choose next? Give it a rating of 2, etc. The one you would do without first would receive a rating of 10.
   d. Write "yes" on the last line if you believe you could reduce the amount of electricity being used by this appliance in the home now.

materials:



activity no. 11

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implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to select an occupation of interest, the student will be able to identify and list the tools, equipment, etc. for the selected occupation which use electrical energy.

Fuelwood Use

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to identify and appraise the use of home appliances, the student will be able to identify those for which the electrical energy use could be reduced.

Developed by: Mabel Lund
Beaverton School District
Beaverton, OR

title: "How Much Electricity Do You Use?"

uses

concept: There are many ways to conserve energy.

objective: Given the opportunity to answer the question "how much electricity do you use," the student will be able to know differences in the amounts of electricity used by various appliances.

time: 1-2 45 minute class periods

subject matter area: Mathematics, Social Science Science

grade: 7-9

implementation:

Activity:

1. Ask question, "How much electricity do you use?"
2. Using Table I, have students make a list of electrical appliances in their home. If there are others which are not mentioned on the list, be sure to include them.
3. Beside each item on their list, have each student write the estimated annual kilowatt-hour (KWH) consumption for that appliance.
4. Add these to give the total KWH consumption for each family.
5. Divide this total by the number of persons in each family to arrive at a per capita annual KWH consumption.
6. Have a class discussion about which home appliances could be used less or discarded in order to reduce electrical consumption.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to select home appliances to discard (for energy conservation purposes,) the student will be able to identify a number of occupations which would be eliminated or which would require adjustment.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to calculate the annual electric energy consumption for the family, the student will be able to participate in a class discussion on how to reduce electrical consumption.

Developed by: Dick Mace
Beaverton School Dist.
Beaverton, OR

activity no. 12

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TABLE I

Electrical consumption for some common home appliances:

APPLIANCE	ESTIMATED ANNUAL KWH CONSUMPTION
Air conditioner, window	940
Bed blanket	147
Broiler	100
Carving knife	8
Clock	17
Clothes dryer	993
Coffee maker	106
Deep fat fryer	83
Dehumidifier	377
Drill, electric	65
Dishwasher	363
Fan, attic	291
Fan, circulating	43
Fan, furnace	450
Fan, window	170
Floor polisher	15
Food blender	15
Food freezer (15 cu. ft.)	1195
Food freezer, frostless (15 cu. ft.)	1761
Food mixer	13
Food waste disposer	30
Frying pan	186
Grill, sandwich	33
Hair dryer	13
Heat lamp	13

TABLE I
(continued)

APPLIANCE	ESTIMATED ANNUAL KWH CONSUMPTION
Heat pump	13
Heater, radiant	176
Heating pad	10
Hot plate	90
Humidifier	163
Iron, hand	144
Iron, mangle	158
Light bulbs	25
Oil burner	410
Radio	86
Radio-phonograph	109
Range	1175
Refrigerator (13 cu. ft.)	728
Refrigerator, frostless (12 cu. ft.)	1217
Refrigerator, freezer, frostless (24 cu. ft.)	1828
Roaster	205
Saw	65
Sewing machine	205
Shaver	18
Sun lamp	16
Television (black and white)	362
Television (color)	502
Toaster	39
Toothbrush	5
Vacuum cleaner	46
Waffle iron	22

TABLE I
(continued)

APPLIANCE	ESTIMATED ANNUAL KWH CONSUMPTION
Washing machine, automatic	103
Washing machine, non-automatic	76
Water heater, standard	4219
Water pump	231

title: "Things I Like To Do"

uses

concept: Every decision made involving energy affects standards of living.

objective: Given the opportunity to make a list of things they like to do, the students will be able to examine the items and determine a value for each.

time: 1 - 30 minute session-depending on grade level

subject matter area: Social studies (values)

grade: 7-9

implementation: Ask the student to make the following chart on a sheet of paper:

Things I like to do	$	E	e	F&/or M	"10"	Date
1. 2. 3. 4. 5.						

Ask the students to make a list of 5-10 things they like to do.

1. Place a $ sign by any item which costs more than $3.00 each time to do it.
2. Put an "E" in front of any item which uses a lot of mechanical energy to perform.
3. Put a small "e" next to the items that require a little mechanical energy to perform.
4. Using the code letters "F" and "M", record which of the items on your list you think your father or mother might have had on their lists if they had been asked to make one at YOUR age. (F= Father and M= Mother)

materials:

Paper
Pencil
"The Nightmare Life Without Fuel," Isaac Asimov, Time, April 25, 1977.

activity no. 13

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implementation:

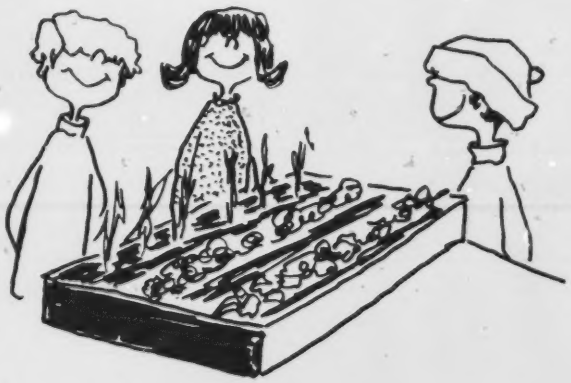
(continued)

5. Place a number "10" in front of any item which you think would not be on your list 10 years from now.
6. Finally, go down through your list and place near each item the date when you did it last.

Discussion: Teacher should ask students for the responses they put down on each item. Ask why?

*Key questions-

1. What does your list tell you about the things you like to do?
2. List ways that you could conserve energy from the list of things you like to do.
3. Did your parents use less energy at your age than you? Why?



materials:

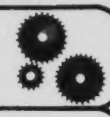
SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity, the student will be able to make a value judgment by making a verbal or written statement about the things he/she likes to do.

Developed by: Dan Grimes
EME

title: "Leisure Time Activities"

uses



concept: Every decision made involving energy affects standards of living.

objective: Given the opportunity to participate in a values clarification exercise, the student will be able to become more aware of the relationship between standard of living and energy use.

time: 1-2 30 minute sessions-depending on grade lev.

subject matter area: Social Studies (values)

grade: 7-9

implementation:

PROCEDURES:

1. Ask each student to make a list of five leisure time activities s/he enjoys doing.
2. Rank in order each activity from the most important to the least important.
3. Next to each item place a $ (dollar sign) if the activity costs money each time it is performed.
4. For each item, assign a mechanical energy point value. Give the activity points according to this scale:
   - 3 points if a major amount of energy is used.
   - 2 points if a moderate amount of energy is used.
   - 1 point if very little energy is used.
   - 0 points if no artificial energy source is used.
5. For each item give :
   - 3 points if the activity is performed a lot.
   - 2 points if performed occasionally.
   - 1 point if performed seldom.
   - 0 points if never done.
6. Add an additional point for each activity with a $ sign.
7. Multiply the Energy Consumption points by the points assigned to the Amount of Use. Indicate this in a column labeled Total Value.

materials:

Copies of a chart like the sample chart attached
Paper
Pencil

activity no. 14

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implementation:

(continued)

8. Assume that a severe energy crisis now exists, and that all people must conserve as much energy as possible. Cut back your leisure time activities so that your point value total is reduced by at least 50%!

9. Retotal the Total Value points after making reductions in the Amount of Use.

Class Discussion for Follow-Up:

1. Are you willing to reduce by 50%? Why or why not?
2. How did you conserve energy? Which items did you reduce?
3. Does your priority ranking affect your decisions? If so, how?
4. Does the $ value have any effect on energy usage?
5. What types of activities can we do that are fun and do not require much use of artifical energy sources?

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity, the student will be able to list ways s/he can conserve energy in leisure time activities.

Developed by: Dan Grimes
EME

Revised by: Jon Thompson
EME

ILLUSTRATION OF ACTIVITY - FOR TEACHER USE ONLY

ACTIVITY	RANKING	$	ENERGY CONSUMPTION	AMOUNT OF USE BEFORE	AMOUNT OF USE AFTER	TOTAL VALUE BEFORE	TOTAL VALUE AFTER
Water skiing	2	$	3	2	1	7	4
Guitar	1	0	0	3	3	0	0
Sailing	4	$	1	2	1	3	2
Motorcycle riding	5	$	1	3	2	4	3
Snow skiing	3	$	2	2	0	5	0
				TOTAL POINTS:		19	9

Before = Before making a reduction in use.

After = After making activity use reductions.

Note: A reduction of more than 50%.

ENERGY CONSUMPTION (Mechanical)

Points	Amount
3	If a major amount of energy is used
2	If a moderate amount of energy is used
1	If very little energy is used
0	If no energy is used

AMOUNT OF USE

Points	Amount
3	If done a lot
2	If done occasionally
1	If done seldom
0	If never done

TOTAL POINT VALUE

To obtain the total point value, multiply the number of points assigned to Energy Consumption by the number of points of the Amount of Use. Add 1 point for each activity with a $ sign. (Remember, zero times any number equals zero.)

Activity	Energy Consumption		Amount of Use	$	Total Value
Flying	3	X	2	+ 1 =	7

USES

CONVERSIONS OF ENERGY

GOAL:

IT IS ESSENTIAL THAT EACH PERSON KNOW THAT ENERGY CAN BE CONVERTED FROM ONE FORM TO ANOTHER.

ACTIVITY
DESCRIPTION PAGE

CONVERSIONS (7-9)

Goal: It is essential that each person know that energy can be converted from one form to another.

Concept: There are natural and artificial energy conversions systems subject to natural laws.

Activity #1 "A Radiometer Experiment"
Grade level 7-8
Science

Given the opportunity to complete an experiment, the student will be able to observe an artificial version of a natural conversion.

Activity #2 "Making Blueprints"
Grade level 7-8
Science, Art

Given the opportunity to make a picture or design using blueprint paper, the student will be able to recognize that a conversion of energy took place as the sun changed the paper color.

Activity #3 "Evaporation - Condensation"
Grade level 8-9
Social Science, Science

Given the opportunity to conduct experiments, the student will be able to realize that energy changes are important in the processes of evaporation and condensation.

Concept: All conversion processes use energy or lose heat energy.

Activity #4 "Energy and A Physical Change Of State'
Grade level 8-9
Science

Given the opportunity to complete an experiment, the student will be able to demonstrate that a physical change of state can involve the absorption of heat energy.

Activity #5 "Liberation of Heat Energy"
Grade level 8-9
Science

Given the opportunity to complete an experiment, the student will be able to demonstrate that a physical change of state can involve the liberation of heat energy.

Activity #6 "The Conversion Process"
Grade level 8-9
Science

Given the opportunity to conduct experiments, the student will be able to define heat, observe heat that accompanies chemical conversion, and use heat to convert substances to other substances.

Concept: Energy "costs" are partly related to the efficiency of energy conversion and transportation.

Activity #7 "Fuel Sources"
Grade level 8-9
Social Science, Science

Given the opportunity to study energy conversion tables, the student will be able to evaluate the commercial conversion of various forms of thermal energy to electrical energy.

Concept: History can be described in terms of the level of energy conversion technology.

Activity #8 "Careers in Nuclear Science"
Grade level 7-9
Career Education, Social Science, Language Arts

Given the opportunity to complete the necessary research, the student will be able to identify career opportunities and educational requirements in the field of nuclear science.

title: "A Radiometer Experiment"

conversion

concept: There are natural and man-made energy conversion systems subject to natural laws.

objective: Given the opportunity to complete and experiment, the student will be able to observe a man-made version of a natural conversion.

time: 1-2 45 minute class periods

subject matter area: Science

grade: 7-8

implementation:

Activity: 1. Below is a list of the procedures to follow to complete this lesson:

a. Set both a radiometer and a lamp on a level table or counter approximately 60 cm from each other. Focusing the lamp on the radiometer, turn on the light and observe the action of the radiometer.

b. Next, vary the distance between the lamp and the radiometer from 30 cm to 2 m and notice any variation in the action of the radiometer.

c. With the lamp approximately 45 cm away from the radiometer, alternately hold and take away an opaque piece of paper in front of the lamp. Note the effects of the speed and completeness with which you block the light on the radiometer.

NOTE: If it is convenient and conditions are suitable, much of the above procedures can be done in sunlight, which may be better in terms of appreciating the concepts and related ideas.

materials:

1 Radiometer
1 Electric lamp, approximately 150 W
1 Opaque sheet of paper

activity no. 1

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implementation:

Activities: (cont.)

2. Have the students discuss the following;
   a. What effect does intensity of light (distance and/or shading) have on the radiometer?
   b. What are some ways a radiometer could be used as an energy source (or a machine for doing work) itself? As a type of solar switch?

3. Have the students investigate each of the following and relate it in some way to the radiometer.
   a. Strobe light
   b. Electric eye
   c. Light meter
   d. Camera
   e. Centrifuge
   f. Thermostat
   g. Turbine generator

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to investigate a number of items related to a radiometer, the student will be able to select one item and identify the occupational skills necessary to use that item on the job.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to complete and experiment, the student will be able to relate (a teacher-determined number of) items to the radiometer.

Developed by: William Kintzley
Olympia, WA

Revised by: Duane K. Altig

title: "Making 'Blueprints'"

conversion

concept: There are natural and man-made energy conversion systems subject to natural laws.

objective: Given the opportunity to make a picture or design using blueprint paper, the student will be able to see that conversion of energy took place as the sun changed the paper color.

time: 2-3 45 minute class periods

subject matter area: Science, Art

grade: 7-8

implementation:

Activity: 1. Day one: The first day will involve a teacher demonstration and individual or group exploration.

a. Teacher demonstration should be conducted in darkened room away from direct sunlight.
- Show blueprint paper and ask if anyone has seen it, knows what it is called or what it is used for.
- Place paper into a gallon jar with paper towels dampened in ammonia and cover tightly. Students will observe that the paper changes color as the ammonia fumes come into contact with it.
- Ask: "What happened to the paper?"
  "What explanation can you give for what happened?"
  "How can you be sure?"
- Repeat the process but this time put paper in a jar that does not contain ammonia.
- Ask: "What is the difference?"

materials:

Blueprint paper
Wide mouth gallon jars with lids
Ammonia solution
Paper towels
Paper to cut into patterns and shapes

activity no. 2

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implementation:

materials:

Activities: (cont.)

b. Student explorations involve the following:
- Provide each group of four children with two bottles, ammonia, paper towels and blueprint paper. Encourage them to experiment with the materials themselves.
- Ask them to try to find a way to make the paper change color without using the ammonia fumes.
- Ask them if they can keep the paper from turning blue when placed in the same ammonia bottle.
- Allow time for group discussion. Ask these questions, "What did you observe?" "What caused the paper to turn blue?"
- If any group discovered that sunlight will cause the paper to turn white, and that the white will not turn blue in the ammonia, allow them to share this with the group. If not, ask them to do some more experimentation to find the effects of some other factors upon the paper, i.e., water, sunlight, alcohol fumes, breath and whatever they come up with.
- Discuss their findings and the change of the paper from green to white when exposed to sunlight.
- Ask: "What happens to the paper when it is put into the ammonia bottle after being exposed to the sun?"
- Explain that blueprint paper is a special paper that is sensitive to the sun's energy. Ask the class if they can think of any ways that the paper might be used. Elicit ideas and tell the class that tomorrow they will have a chance to use the blueprint paper for a special art project.

implementation:

Activities: (cont.)

2. Day two: The blueprint paper will be used for various art projects by the students.

   a. Below is a list of some suggested activities:
   - Cut shapes from construction paper to be placed on blueprint paper to form a picture or design. Expose to sunlight and quickly "fix" the picture by placing it in a bottle with ammonia fumes.
   - Cut squares of paper to make a positive-negative space design. (see attached examples.)
   - Experiment with exposing different parts of the paper for differing amounts of time.

   b. It should be noted that the art lesson should be done out of direct or bright light. Even indirect sunlight may cause the paper to fade. An easy way to do this is to close drapes or shades and allow students to work in front of the windows so that papers need not be moved after the shapes have been placed. Then curtains or shades can be opened to expose the pictures and closed to remove the shapes and "fix" the pictures. If this is not possible, shapes may be stuck on paper with little rolls of tape and then removed after exposure to light.

   c. Conclude this activity by discussing the evidence of energy transfer as observed in the paper change. Have students identify energy source (sun), energy receiver (blueprint paper) and evidence of energy conversion (paper changes color).

materials:

implementation:

Activities: (cont.)

Optional activities

1. Discussion of the chemical energy conversion that takes place as the ammonia fumes cause the unexposed blueprint paper to change color.

2. Experiment with time exposure and its effects by moving the cutout designs somewhat during exposure to the sun.

3. Vary the amount of exposure by allowing exposure through different materials over the same period of time. This could even become a project of making a positive negative.

4. Relate this work with the way a camera works. How are they alike and different?

EXPOSURE

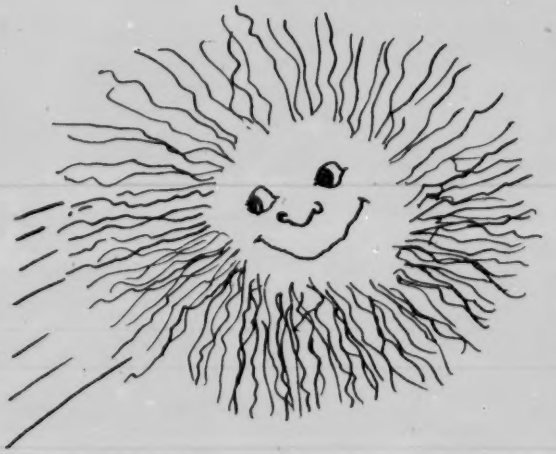
SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to investigate the occupations in the area of art, the student will be able to identify the basic skills common to most art occupations.

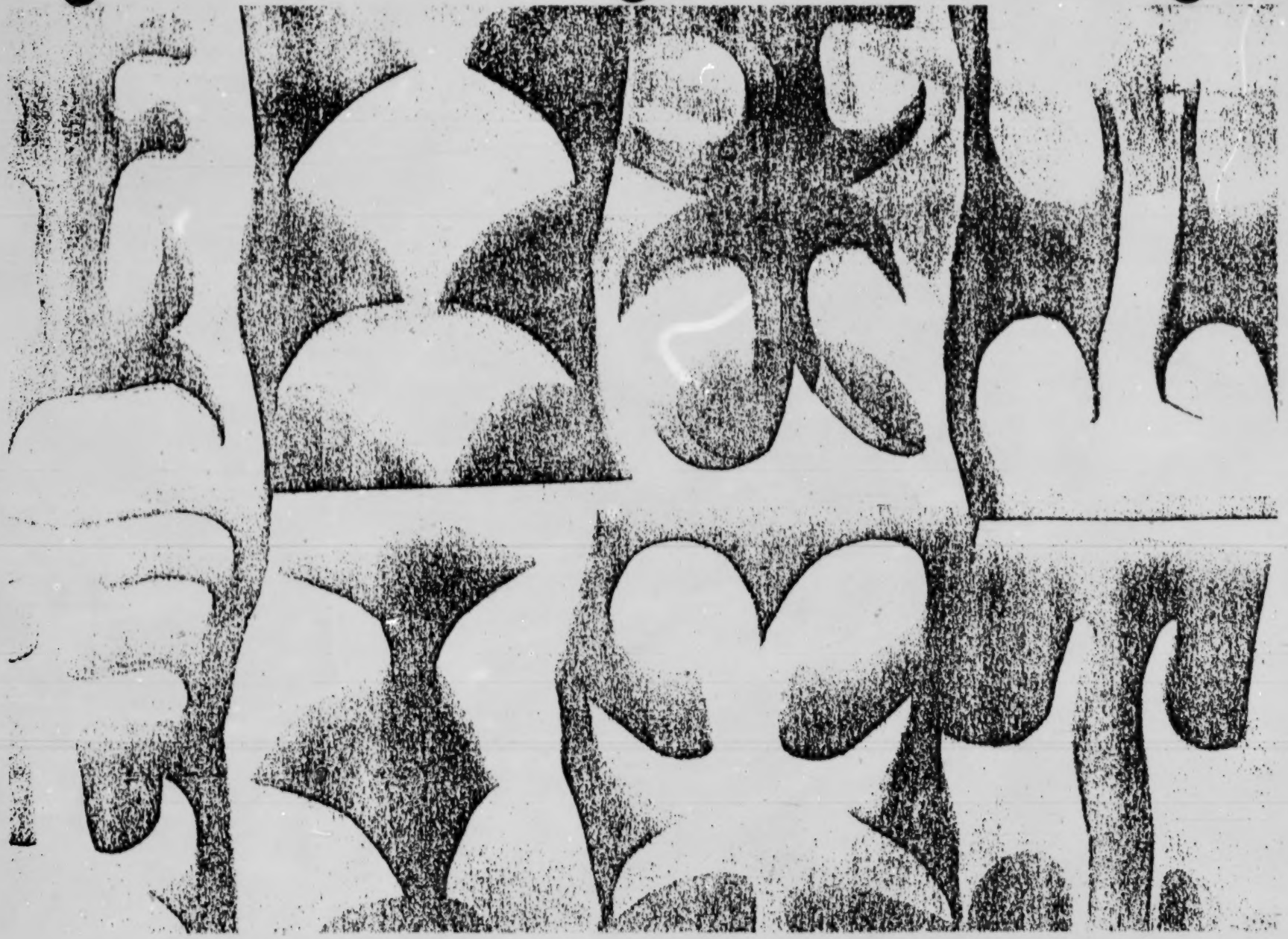
materials:

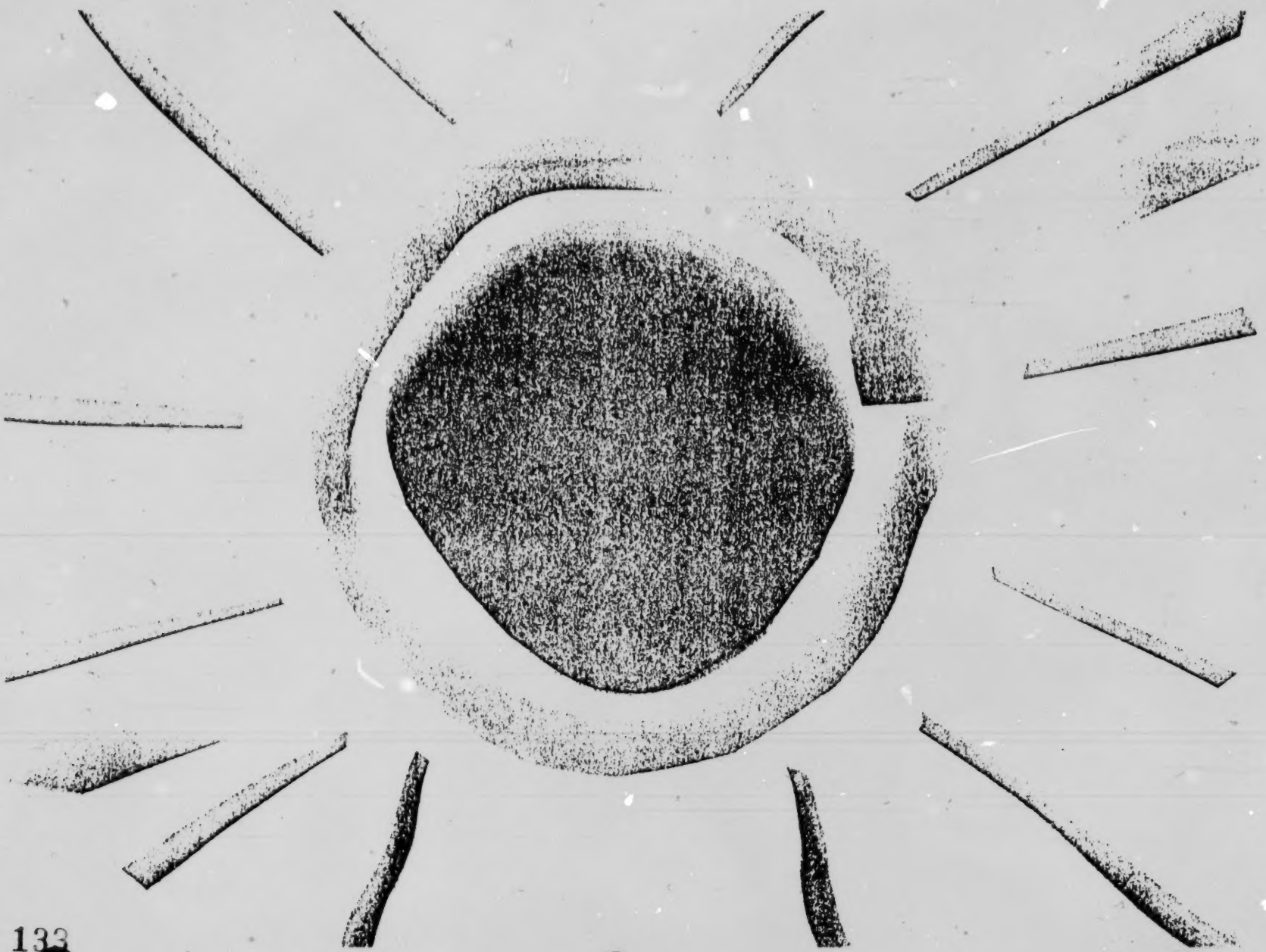
SUGGESTED ASSESSMENT PROCEDURE:

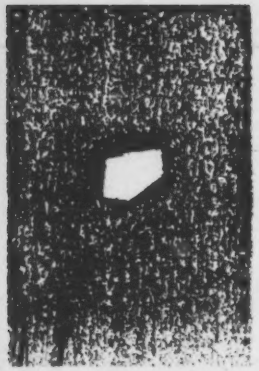
Given an opportunity to make a picture or design on blueprint paper, the student will be able to recognize the energy conversion that took place as the sun exposed the blueprint paper and the paper turned white.

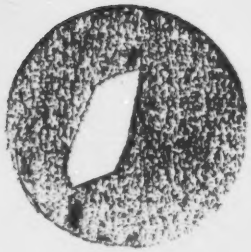


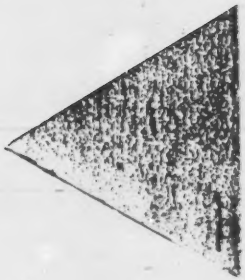
Developed by: Janet K. Boston
Olympia, WA











CONVERSION

title: "Evaporation - Condensation "

conversion

concept: There are natural and man-made energy conversion systems subject to natural laws.

objective: Given the opportunity to conduct experiments, the student will be able to realize that energy changes are important in the processes of evaporation and condensation.

time: 1- 45 minute class period

subject matter area: Social Science, Science

grade: 8-9

implementation:

Activity: 1.

Procedures:

a. Wet the end of one of your fingers with a small amount of water. Hold your finger several inches from your face and gently blow on it. Describe the feeling.
   - Question: If you continue to blow for a minute or so, what happens to the water?

b. Repeat the above procedure but this time swab a small amount of alcohol on the end of your finger.
   - Question: Is the feeling any different than when you used water? If so, what is the difference?

c. With eye droppers carefully put one drop each of water and alcohol on the table top or wherever designated, side-by-side. Gently fan the drops with a piece of paper.
   - Question: Which drop disappears first? Approximately how long did it take? What is the process of disappearing called? Where did the liquids go?

materials:

Materials per group performing the activity.
2 eye droppers
1 small can (soup can with paper removed)
Water
Alcohol
Ice cubes

activity no. 3

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implementation:

Activities: (cont.)

d. Fill a small tin can with tap water and drop in a couple of ice cubes. Make sure that the outside of the can is wiped dry. Set the can on your desk and watch it for several minutes, observing especially the outside of the can.
- Question: What do you observe?

2. Some discussion during and/or following this activity is important. Some terms such as evaporation and condensation will probably enter into the discussion. The idea of heat energy as a necessary part of the processes should be stressed. The students should be asked to think of examples of these processes that occur in nature (weather).

3. Related activities:

a. Create Tomorrow....Today, an Energy Awareness Program published by the Washington State Superintendent of Public Instruction, 1974.
- Secondary page 8 #21, #24, #26
page 9 #28, #29, #31
page 11 #47
Available from: Analysis Center
Ohio State University
1200 Chambers Road
Columbus, Ohio 43212
Re: Eric-ED189-993

SUGGESTED CAREER EDUCATION ACTIVITY: None

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to take part in several small experiments, the student will be able to relate the concepts of evaporation and condensation to changes in energy.

Developed by: William Kintzley
Olympia, WA

title: "Energy and A Physical Change of State"

conversion

concept: All conversion processes use energy or lose heat energy.

objective: Given the opportunity to complete an experiment, the student will be able to demonstrate that a physical change of state can involve the absorption of heat energy.

time: 1 - 45 minute class period

subject matter area: Science

grade: 8-9

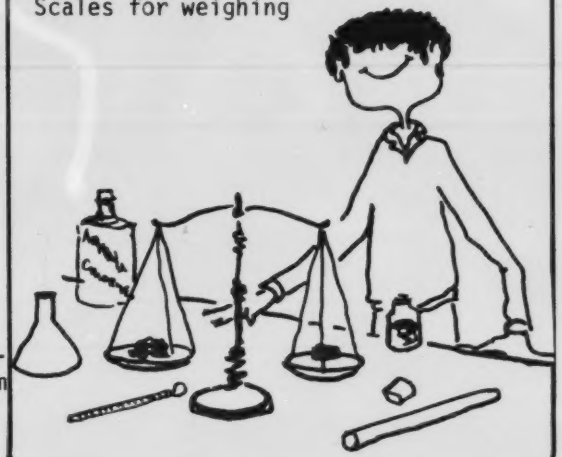
implementation:

Activity:

1. Procedure: Have the students weigh out approximately 3 g of ammonium chloride granules and put them in a large test tube.
   a. The students should then obtain 10 to 15 ml of tap water in a second test tube or graduated cylinder.
   b. With a thermometer, determine the temperature of the water in this second container.
   c. Now pour the water into the test tube containing the ammonium chloride, add a stopper and shake for a few seconds.
   d. After about two minutes shake again for a few seconds and then with the thermometer determine the temperature of the solution.
2. NOTE: This exercise can be done as a demonstration if facilities prohibit small groups of students from doing it themselves. The quantities of water and ammonium chloride are not critical. Other chemicals which illustrate an endothermic process can be used, such as ammonium nitrate (as used in first aid cold-pack replacements).

materials:

Materials per group doing exercise:
2 test tubes, 20 or 25 X 150 mm
1 solid stopper, to fit test tube
1 20 ml graduated cylinder
Ammonium chloride - max. of 5 g water
1 thermometer
Scales for weighing



activity no. 4

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implementation:

Activities: (cont.)

Optional Activities

a. Create Tomorrow...Today, an Energy Awareness Program published by the Washington State Superintendent of Public Instruction, 1974.
- Secondary page 8 #21, #24, #26
page 9 #28, #29, #31
page 11 #47

Available from: Analysis Center
Ohio State University
1200 Chambers Road
Columbus, Ohio 43212
Re: Eric-ED189-993

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to complete an experiment related to the conversion and transfer of energy, the student will be able to identify commercial and industrial applications of the process and identify occupations related to the commercial and industrial applications.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to complete an experiment related to physical change and the absorption of heat energy, the student will be able to participate in a class discussion on the implications of the experiment as it applies to the necessity and usefulness of energy and its conversion and transfer.

Developed by: William Kintzley
Olympia, WA

title: "Liberation of Heat Energy"

conversion

concept: All conversion processes use energy or lose heat energy.

objective: Given the opportunity to complete an experiment, the student will be able to demonstrate that a physical change of state can involve the liberation of heat energy.

time: 1 - 45 minute class period

subject matter area: Science

grade: 8-9

implementation:

Activity: 1. Procedure: The student should weigh out about 3 to 5 g of sodium thiosulfate and put it into a test tube until approximately 1/3 full.

a. Then place the test tube upright in a hot water bath, being careful not to tip it over or allow any water to get inside of the test tube.

b. A large beaker or coffee can partly filled with water and heated with an electric hot plate or gas burner can act as a common water bath for all of those taking part.

c. After several minutes the chemical will have melted and the water bath will probably be near boiling.

d. With test tube clamps carefully remove the test tubes from the hot water bath and gently lower them into a similar container containing cold water and a few ice cubes, if available.

e. After approximately two minutes the test tubes can be removed from the cold water bath. At this point some important observations should be made.

materials:

Materials per individual or small group:
- 2 large beakers or 2 lb. coffee cans
- 1 hot plate or gas burner
- 1 test tube, 150 mm
- 1 test tube clamp
- 3 to 5 g sodium thiosulfate, hydrated (hypo)

It is important that all glassware and chemicals used be as clean as possible to avoid premature solidification.

activity no. 5

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implementation:

Activities: (cont.)

The chemical and test tube is cold and it has not frozen (solidified) as probably expected.

f. While holding the test tube so that the bottom rests on the palm of the hand and so that any changes which take place inside can easily be seen, drop in a small crystal of sodium thisulfate that is in the test tube.

g. The results will be apparent and discussion should follow as to what is seen and felt. Discuss exothermic reactions and that energy is involved in changing the states of matter.

Optional Activities:

a. Create Tomorrow....Today, an Energy Awareness Program published by the Washington State Superintendent of Public Instruction, 1974.
- Secondary page 8 #21, #24, #26
page 9 #28, #29, #31
page 11 #47

SUGGESTED CAREER EDUCATION ACTIVITY: None

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to complete an experiment related to physical change and the liberation of heat, the student will be able to participate in a class discussion related to the implications of the necessity and usefulness of energy and its conversion and transfer.

Developed by: William Kintzley
Olympia, WA

title: "The Conversion Process"

conversion

concept: All conversion processes use energy or lose heat energy.

objective: Given the opportunity to conduct experiments, the student will be able to define heat, observe heat that accompanies chemical conversions, and use heat to convert substances to other substances.

time: 2 - 45 minute class periods

subject matter area: Science

grade: 8-9

implementation:

Activity:

1. This learning activity is made up of six experiments. Each experiment is outlined on the following pages. They are organized under the following concepts.

   a. Heat is molecular motion. (1 & 2)
   b. Chemical reactions are accompanied by heat. (3 & 4)
   c. Heat can change the chemical composition of substances. (5 & 6)

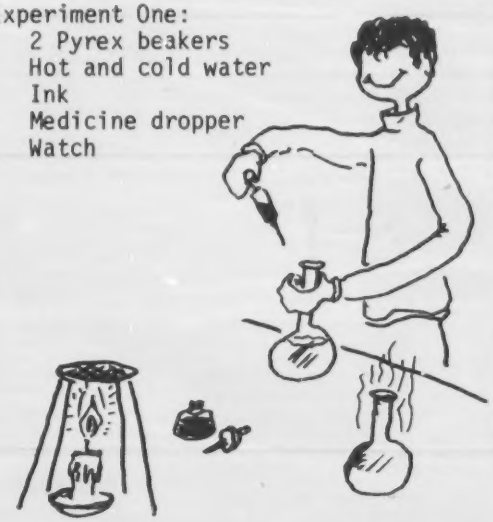
2. Experiment One: Heat is the energy of moving molecules.

   a. Fill the two beakers almost to the top. One should be filled with very hot water and the other with cold water. Let them stand until they are very still.
   b. Put four drops of ink into each with the medicine dropper. Note the exact time.
   c. Why does the ink move even in the still water? In which beaker does the ink move most rapidly? How long does it take the ink to become completely mixed in the hot water? How long does it take in the cold water? What is your explanation for the time difference?

materials:

Materials for each experiment is listed to the right of the experiment.

Experiment One:
- 2 Pyrex beakers
- Hot and cold water
- Ink
- Medicine dropper
- Watch



activity no. 9

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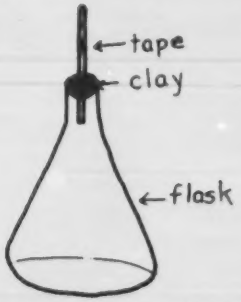
implementation:

Activities: (cont.)

3. Experiment Two:

a. Fill the flask to the top with water and add a few drops of ink. Place the modeling clay and tube in the flask. Press down until the ink rises in the tube. Mark this with a piece of tape.



b. Hold your hands around the flask for five minutes. What happens? Measure the rise in the column of water above the taped mark.

c. Repeat this with the vacuum bottle that has been removed from its case. Compare the results. Find an average for each container.

d. How can you explain the difference in the rise of the column of water in the flask and the vacuum bottle?

4. Experiment Three: Chemical reactions are accompanied by heat.

a. Place about 120 ml of water in each beaker. Measure the temperature of the water.

b. Place about one tablespoon of detergent in one beaker. Stir both beakers for four seconds.

materials:

Experiment Two:
- Flask
- Small Vacuum bottle
- Modeling clay
- Long glass tube
- Water
- Ink

Experiment Three:
- Thermometer
- 2 beakers
- Water
- Powdered detergent

implementation:

materials:

Activities: (cont.)

Experiment Three (continued):

c. Measure the temperature in each beaker. What did you observe? Do you think that energy was given off? Do you think that a chemical change took place? Give reasons for your answers. Why did you use two beakers of water?

5. Experiment Four:

a. Mix 1-1.5 g of powdered iron, 3-4 g of sodium chloride, and place in one test tube. Place an equal amount of sodium chloride in the other test tube.

b. Record the temperature in each test tube.

c. Add 15 ml of water to each test tube and stir.

d. Record the temperatures in each test tube several times until both reach the same temperatures. Record the time and temperature at each measurement.

e. Place the iron-sodium chloride mixture on a newspaper for a few days.

f. What did you observe about the temperature in each test tube? What happened to the mixture on the newspaper? Does the chemical change of rusting produce heat? Does rusting change the color of the iron? What was the reason for the salt in the experiment.

Experiment Four:
- 1-1.5 g of powdered iron
- 3-4 g of sodium chloride
- 2 thermometers
- 2 test tubes
- Beakers of water

6. Experiment Five: Heat can change the chemical composition of substances.

a. Mix the copper oxide and charcoal and place in the test tube.

Experiment Five:
- 1.2 g copper oxide
- 0.6 g powdered charcoal
- Test tube
- Test tube clamp
- Ring stand
- Bunsen burner

implementation:

materials:

Activities: (cont.)

Experiment Five (continued):

b. Place the test tube at a 45 degree angle away from you and anyone else and heat the tube for two minutes. Look inside the test tube above the heated mixture. What do you see? What is the reason for using the charcoal?

7. Experiment Six:

a. Fill the test tube about half full of coal. Place the test tube at a 45 degree angle and heat with the hot part of the flame. Be sure that the test tube is aimed away from you and others.

b. Light the gas that is given off from the tube. Stop heating when no more gas is given off.

c. Let the test tube cool and break it open and examine the coke at the bottom and the brown coal tar about half way up the tube.

d. What kind of chemical change took place? What are coal gas, coal tar and coke used for?

8. Complete the written work for each of the experiments.

Experiment Six:
- Small amount of crushed bituminous coal.
- Test tube
- Test tube clamp
- Ring stand
- Bunsen burner
- Single-hope stopper with pyrex blass or metal tube.

implementation:

Activities: (cont.)

9. Ask these questions in a test situation or in an interview.
   - What is heat? Heat is molecular motion.
   - Molecules are being rearranged in some chemical reactions. How is it that heat is present in these? The movement or rearrangement of these molecules produces heat.
   - How can heat bring on chemical changes in substances? Heat, especially when a catalyst is present, speeds up the molecules sufficiently so that the molecules rearrange themselves or form new substances.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to complete six experiments on conversion processes of energy, the student will be able to identify, through research, 4 occupations related to the processes involved in the experiments.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to complete 6 (six) experiments, the student will be able to complete the written work for the six experiments and answer 3 essay-type questions related to the six experiments.

Developed by: Robert M. Rice
Olympia, WA

Revised by: Duane K. Altig

title: "Fuel Sources"

conversion

concept: Energy "costs" are partly related to the efficiency of energy conversions and transportation.

objective: Given the opportunity to study energy conversion tables, the student will be able to evaluate the commercial conversion of various forms of thermal energy to electrical energy.

time: 1 - 45 minute class period

subject matter area: Social Science, Science

grade: 8-9

implementation:

Activity: 1. The student will use the enclosed chart to answer the questions on the worksheet.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to visit a place of employment, the student will be able to identify the various forms of energy conversions related to the job of one individual at the place of employment.

materials:

One chart per student, enclosed.
One worksheet per student, enclosed.

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to study a chart of fuel comparisons, the student will be able to complete all ten questions on a worksheet related to the fuel comparisons chart.

Developed by: Robert M. Rice
Olympia, WA

activity no. 7

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COMPARISON OF FUELS USED TO PRODUCE ELECTRICAL ENERGY

	Coal	Fuel Oil	Gas	Nuclear
Cost per 1,000 Kilowatts	14¢	15¢	15½¢	12¢
Acres of land used to supply fuel and dispose of wastes over the life of the plant	22,400	1,600	3,600	1,000
Acres required for fuel storage	45 for 2 mo. supply	20 for 18 mil. cu. ft.	small	small
Fuel transport/year	27,000 railroad cars	100 tankers	0	5 trucks
Pollution without abatement per year in tons (particulate, sulfur dioxide, oxides of nitrogen)	417,000	100,600	13,938	11,810

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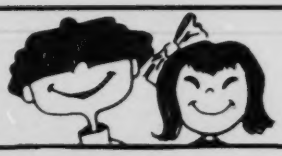

activities

WORKSHEET

1. Which fuel source is the most costly?_____
2. Which fuel source is the cheapest? _____
3. _____requires the use of the most land for a fuel source?
4. _____requires the use of the least amount of land for a fuel source?
5. Which fuel source uses the least land for storage?_____ _____ and _____
6. Which fuel source uses the least amount of transportation.
7. The _____method uses the most transportation.
8. Which method produces the least amount of pollution?_____
9. Which fuel source would you use to produce electricity?_____
10. Explain in detail why you would use the fuel source in number nine to produce electricity. Give reasons and be exact. Use the space below.

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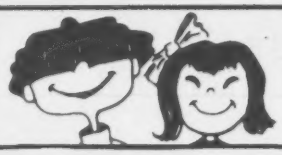

activities

ANSWERS TO WORKSHEET

1. Gas
2. Nuclear
3. Coal
4. Nuclear
5. Gas and nuclear
6. Gas
7. Coal
8. Nuclear

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title: "Careers in Nuclear Science"

conversion

concept: History can be described in terms of the level of energy conversion technology.

objective: Given the opportunity to complete the necessary research, the student will be able to identify career opportunities and educational requirements in the field of nuclear science.

time: Variable

subject matter area: Career Education, Social Science, Language Arts

grade: 7-9

implementation:

Activity: 1. To the student: The following are addresses of various resources from which you may obtain information related to career opportunities in nuclear science. (To assure response to your requests, attach a stamped self-addressed envelope).

a. Society of Nuclear Medical Technologists
P. O. Box 284
Arlington Heights, Ill. 60006

b. National Science Foundation
1800 G. Street, N. W.
Washington, D.C. 20550

c. The American Society of Radiologic Technologists
645 North Michigan Avenue Room 620
Chicago, Ill. 60617

d. Careers (Career Publications)
Box 135
Largo, FL 33540

materials:

activity no. 8

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implementation:

Activities: (cont.)

e. National Center for Information on Careers in Education
1607 New Hampshire Avenue N.W.
Washington, D.C. 20009

f. Society for Range Management
Executive Secretary
Francis T. Calbert
2120 S. Birch Street
Denver, CO 80222

2. After you have received your information, identify that career which interests you most. List in order the educational and other preparatory needs to meet the requirements.

3. To the teacher: This activity may also be used in a communication skill study for Language Arts.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to gather the necessary information related to career training needs for an occupation of interest, the student will be able to plan a 3-4 year forecast of high school courses which would provide basic skills toward obtaining the career training needs of the selected occupation.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to write and obtain information from a variety of resources, the student will be able to list the educational and other preparatory needs to meet the requirements of a selected career interest.

Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

CONVERSION

IMPACTS OF ENERGY

GOAL:

IT IS ESSENTIAL THAT EACH PERSON KNOW HOW PEOPLE'S USE OF ENERGY CREATES AN IMPACT ON ENVIRONMENTAL AND ECONOMIC SYSTEMS.

ACTIVITY
DESCRIPTION PAGE

IMPACTS (7-9)

Goal: It is essential that each person know how humankind's use of energy creates an impact on the environmental and economic systems.

Concept: The use or non-use of any energy source requires environmental trade-offs.

Activity #1 "A Choice of Home Heating Sources"
Grade level 8-9
Social Science, Language Arts, Science

Given the opportunity to do background research, the student will be able to identify some of the advantages or disadvantages of several kinds of home heating.

Concept: Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

Activity #2 "Selection Of A Power Plant Site"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to participate in a field trip, the student will be able to collect data related to decisions made in selection of a Power Plant site.

Activity #3 "Future Nuclear Plant Sites"
Grade level 8-9
All Subject Matter Areas

Given the opportunity to role play, the student will be able to describe reactions to future siting possibilities for nuclear power plants.

Activity #4 "Unwise Energy Use"
Grade level 9-10
Language Arts, Speech, Social Science

Given the opportunity to observe the interactions of people regarding energy use choices, the student will be able to confront (hypothetically and in reality) any source of "unwise" energy use.

Activity #5 "Lifestyle Choices and Energy Use"
Grade level 9-10
All Subject Matter Areas

Given the opportunity to assess a list of personal energy use choices, the student will be able to form judgments using terms good, bad, right, wrong, better, worse, etc. with regard to lifestyle choices that deal with energy use.

Concept: Efforts to regulate energy producers and users require energy, economic allocation, and political effort.

Activity #6 "Zoning and Energy Requirements"
Grade level 7-8
Social Science

Given the opportunity to make a planned field trip, the student will be able to understand zoning laws and their interrelation with the factors of aesthetics, convenience, and energy requirements.

Activity #7 "Traditional Values and Energy-Use Problem Solving"
Grade level 8-9
Language Arts, Social Science

Given the opportunity to collect the necessary materials, the student will be able to use information from local decision-making groups (planning boards, city council) to apply traditional values listed to the decision-making process and describe their impact upon energy-use problem solving.

Concept: Some uses of energy are more threatening to ecosystems than are others.

Activity #8 "What's In The Air? Who Put It There?"
Grade level 7-9
Language Arts, Social Science, Science

Given the opportunity to gather the necessary background data, the student will be able to identify several forms of air pollution and how much of it occurs.

Concept: Industrial societies have a greater impact on the environment than do agrarian societies.

Activity #9 "Then And Now"
Grade level 7-9
Social Science, Language Arts

Given the opportunity to compare pictures, the student will be able to describe the changes that have occurred from the past to the present in household chores and activities (i.e., cooking, lighting, sewing, etc.)

Activity #10 "A Land Use Attitude Survey"
Grade level 8-9
Social Science, Language Arts, Science

Given the opportunity to review a sample survey, the student will be able to construct and administer an attitude survey about land use.

title: "A Choice Of Home Heating Sources"

impacts

concept: The use or non-use of any energy source requires environmental trade-offs.

objective: Given the opportunity to do background research, the student will be able to identify some of the advantages or disadvantages of several kinds of home heating.

time: 3-4 45 minute class periods

subject matter area: Social Science, Language Arts, Home Economics

grade: 8-9

implementation:

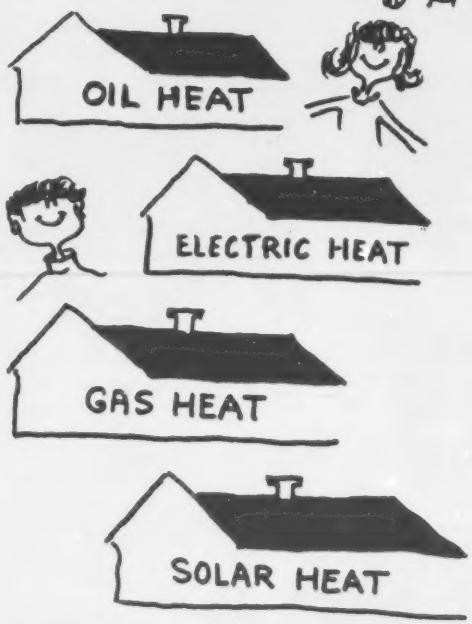
Activity:

1. Present to the students a verbal description of several homes which are identical in size and construction. The families living in them share similar living patterns. The only differences are the different heat sources for the homes, and these sources are to be considered in terms of their contributions to air pollution.

2. Have students list types of expected pollution. These might include:

   Heat loss to outside
   Stack heat loss
   Duct loss
   Emission of unburned hydrocarbons
   NO_x
   Visual impairment
   Others

materials:



activity no. 1

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implementation:

materials:

Activity: (continued)

3. Have students use reference materials in order to learn about relative differences, listing their results in tabular form:

Heat Source	Oil	Gas	Electricity
Heat Loss:			
Stack			
Burner			
Duct			
Hydrocarbons			
NO_x			
Visual			
Others			

4. Ask the question, "What other factors would affect your choice of heat?"

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to listen to a speaker from a local utility company, the student will be able to understand the employment opportunities in the area of public utilities.

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to research the the differences in heating sources, the student will be able to identify the advantages and disadvantages of several kinds of home heating.

Developed by: Ted Parker
Beaverton School District
Beaverton, OR

title: "Selection Of A Power Plant Site"

impacts

concept: Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

objective: Given the opportunity to participate in a field trip, the student will be able to collect data related to decisions made in selection of a power plant site.

time: Variable

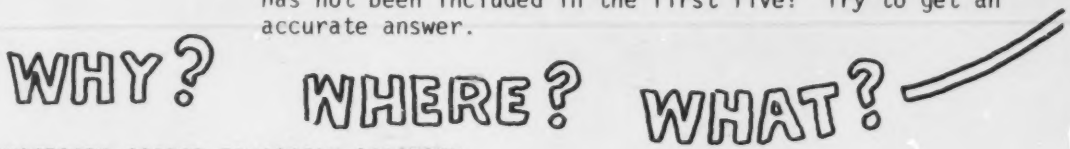
subject matter area: All

grade: 7-9

implementation:

Activity: 1. A group of students will take a field trip to an electricity generating plant. They will seek answers to the following questions:

a. Why was a plant built here?
b. Could it have been built at a different location?
c. What kind of fuel is used?
d. Where does the fuel come from?
e. How is air pollution controlled?
f. What question do you think is especially important, yet has not been included in the first five? Try to get an accurate answer.

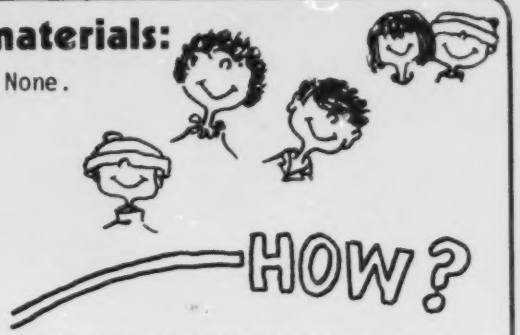


SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to interview workers at a power plant site, the student will be able to identify the educational and training backgrounds of a variety of workers at the plant site.

materials:

None.



SUGGESTED ASSESSMENT PROCEDURE:

Given an opportunity to take a field trip to an electricity generating plant, the student will be able to gather answers to questions related to the decisions made in selection of a power plant site.

Developed by: Mable M. Lund
Beaverton School Dist.
Beaverton, OR

activity no. 2

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title: "Future Nuclear Plant Sites"

impacts

concept: Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

objective: Given the opportunity to role play, the student will be able to describe reactions to future siting possibilities for nuclear power plants.

time: 3-4 45 minute class periods

subject matter area: All

grade: 8-10

implementation:

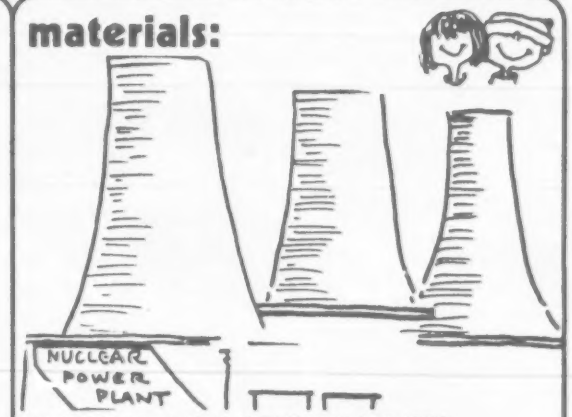
Activity:

1. Choose locations for three new generating plants in your state. Establish their exact sites.
2. Discuss the characteristics of the fuel to be used in the plants.
3. Discuss the transportation problems related to fuel and waste. See Activity #1 in this section for other impacts.
4. What might the reactions to each site be from: a banker, a housewife, a person picked at random, an industrialist, a conservation club president, a hospital manager, a realtor, and a supermarket owner?
   a. Have students role-play possible responses from these various concerned citizens.
   b. Ask students to discuss their own reactions to each site.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the situation of the possibility of a nuclear power plant, the student will be able through class discussion, to identify reasons why some occupations and/or lifestyles may differ on their judgments relative to the trade-offs involved in nuclear power plant development.

materials:



SUGGESTED ASSESSMENT PROCEDURES

Given the necessary background information, the student will be able to role play the reactions of a variety of individuals to the siting of future nuclear power plants.

Developed by: Dick Mace
Beaverton School District
Beaverton, OR

activity no. 3

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title: "'Unwise' Energy Use"

impacts

concept: Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

objective: Given the opportunity to observe the interactions of people regarding energy use choices, the student will be able to confront (hypothetically and in reality) any source of "unwise" energy use.

time: 4-5 45 minute class periods

subject matter area: Language Arts, Speech, Social Science

grade: 9-10

implementation:

Activity:

1. After observing a mock confrontation over energy use between two parties, students will try to evaluate why and how people are resistant to behavioral change. Also, each student will list possible steps that s/he would take in trying to change a person's behavior.
2. Analyze and evaluate in class the steps listed by students.
3. Have students divide into two main groups, protagonist and antagonist. Have the members of the protagonist group prepare short justifications for their unwise way of consuming energy. Have the antagonists each devise approaches to persuade or influence the others.
4. Randomly select any two or three students, protagonist and antagonist, and have them perform a short confrontation scene. Class evaluates approaches to persuasion.
5. Students are encouraged to confront people littering or being wasteful of resources, etc. and report the reaction of the offender to the attempts to influence him/her.

materials:

activity no. 4

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implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify unwise uses of resources, the student will be able to identify occupations which are directly related to unwise energy use.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to observe interactions of people regarding energy use choices, the student will be able to report the reactions of people to confrontations relative to unwise uses of resources.

Developed by: G. Lass
Beaverton School Dist.
Beaverton, OR

title: "Lifestyle Choices And Energy Use"

impacts

concept: Conflicts over ecologically sound practices and aesthetic judgments will involve trade-offs if they are to be resolved.

objective: Given the opportunity to assess a list of personal energy-use choices, the student will be able to form judgments using terms good, bad, right, wrong, better, worse, etc., with regard to lifestyle choices that deal with energy use.

time: 3- 45 minute class periods

subject matter area: All

grade: 9-10

implementation:

Activity:

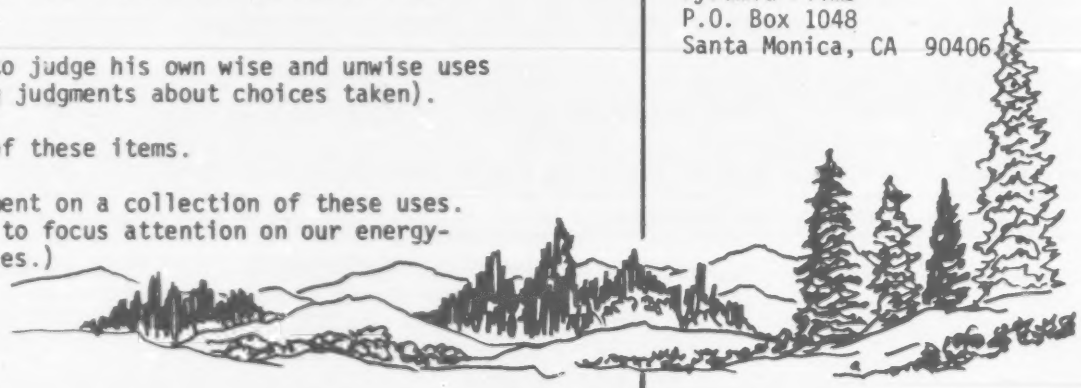
1. The student is to assess the ways in which s/he uses energy. It should be emphasized that personal choice is involved in energy use.
2. Student assigns priorities within the list in terms of necessity.
3. Student then attempts to calculate roughly the gross amount of energy he uses over a set period of time (day, week, etc.).
4. Student attempts to judge his own wise and unwise uses of energy (forming judgments about choices taken).
5. Class discussion of these items.
6. Class passes judgment on a collection of these uses. (This is intended to focus attention on our energy-intensive lifestyles.)

materials:

Films

"The Energy Dilemma"
Films, Inc.
5625 Hollywood Blvd.
Hollywood, CA 90028

"Leisure"
Pyramid Films
P.O. Box 1048
Santa Monica, CA 90406



activity no. 5

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implementation:

7. Student expands awareness to the community and larger spheres. Lists energy-using activities and attempts to pass judgment on them justifying their conclusions.

8. Some kind of tally of "goods" and "bads" to be brought to class attention.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to evaluate the energy uses of given lifestyles, the student will be able to identify through class discussions occupations which produce greater uses of energy.

materials:

SUGGESTED ASSESSMENT PROCEDURES:

Given the opportunity to evaluate the advantages and disadvantages of energy intensive lifestyles, the student will be able, through class discussion, to generate a list of good and bad uses of energy-using activities.

Developed by: G. Lass
Beaverton School Dist.
Beaverton, OR

title: "Zoning And Energy Requirements"

impacts

concept: Efforts to regulate energy producers and users require energy, economic allocation and political effort.

objective: Given the opportunity to make a planned field trip, the student will be able to understand zoning laws and their interrelation with the factors of aesthetics, convenience and energy requirements.

time: Variable

subject matter area: Social Science

grade: 7-8

implementation:

Activity:

1. The teacher should get one or more copies of zoning maps of the local town or city. After studying the maps, the class should plan a field trip (by bus?) that will take them through a variety of zones, e.g., industrial, commercial, agricultural, residential and recreational.

2. On the planned field trip, students should correlate the buildings and structures they are passing with the zones on the map. They should recognize variations within a given zone, e.g., light and heavy industrial zones.

3. Upon returning to the classroom from the field trip, the students should discuss what they have seen in terms of:
   a. Quality of life affected by zoning. "How would you like to live by the bus barn? Above a store? Across from a pool?"
   b. Economic (energy) reasons for zoning.
   c. Economic (people's time) reasons for zoning.

4. A member of the local planning commission should be invited to discuss the criteria for zoning the area visited by the students. Are energy requirements considered in zoning a city?

materials:

Zoning maps of the local area.

activity no. 6

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implementation:

Optional Activities:

1. Have small groups plan a community for 5,000-10,000 residents, showing how they would zone it and giving reasons for their choices.

2. For a more advanced (older?) class, have them plan a community for 5,000-10,000 residents
   - on a large lake
   - with scattered small lakes and a river
   - in a hilly or mountainside area
   - at the edge of a swamp

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to study the various zones of a city, the student will be able to identity the training and skill requirements of a variety of occupations related to city planning.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to make an organized field trip through a city, the student will be able to relate in a class discussion, how zoning laws and aesthetics, convenience, and energy requirements interrelate.

Developed by: Lois Helton
Beaverton School District
Beaverton, OR

Revised by: Duane K. Altig

title: "Traditional Values And Energy-Use Problem Solving"

impacts

concept: Efforts to regulate energy producers and users require energy, economic allocation and political effort.

objective: Given the opportunity to collect the necessary materials, the student will be able to use information from decision-making groups (planning boards, city council) to apply traditional values used in the decision-making process and describe their impact upon energy-use problem solving.

time: 3-4 45 minute sessions

subject matter area: Language Arts, Social Science

grade: 8-10

implementation:

Activity:

1. Students keep a collection of news articles about local decision-making processes concerning all environmental issues, especially the reactions of local leaders to federal-state-regional programs.

2. Students are instructed about the historical bases of the traditional values of individualism, privacy, fear of big government, local control, free enterprise and so on. Now our vast complex society needs to re-evaluate these ideals in light of the resource-use control programs that will soon be necessary.

3. A field trip to a local council meeting, or a comparable body, would enhance understanding of the process.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given an opportunity to discover the values related to work, the student will be able to relate personal values with the values of work.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given an opportunity to collect newspaper articles related to environmental issues, and obtain the background knowledge of historical base of the traditional values, the student will be able to make judgments or generalizations about the traditional values as they obstruct the formulation of sound, comprehensive energy policies.

Developed by: G. Lass
Beaverton School Dist.
Beaverton, OR

activity no. 7

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title: "What's In The Air? Who Put It There?"

impacts

concept: Some uses of energy are more threatening to ecosystems than are others.

objective: Given the opportunity to gather the necessary background data, the student will be able to identify several forms of air pollution and how much of it occurs.

time: 4-5 45 minute class periods

subject matter area: Social Studies, Language Arts

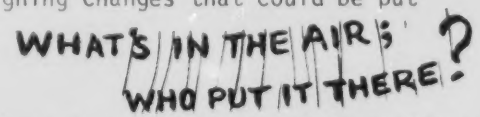
grade: 7-9

implementation:

Activity:

1. Using the theme "What's In The Air? Who Put It There?", contact the local or state agencies and collect information regarding the types and amount of air pollution in the local area:
   State Department of Environmental Quality (For the State of Oregon: Telephone: 229-5696, Portland, Oregon)
   Oregon State Graduate Center for Study and Research (for Oregonians especially), 19600 N. W. Walker Road, Beaverton, Oregon 97005

2. Choose any two types of air pollution and design a plan for each that would reduce the amount of pollution. These plans should involve as many people as possible. The activity should be practical, designing changes that could be put into effect now.



SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to complete the necessary research, the student will be able to identify the responsibilities of an environmental technician and list other occupations that would be involved in the construction and monitoring of air pollution control devices.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given an opportunity to collect the necessary information, the student will be able to select two types of air pollution and design a plan for each that would reduce the amount of pollution.

Developed by: Mabel M. Lund
Beaverton School Dist.
Beaverton, OR

Revised by: Duane K. Altig

activity no. 8

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title: "Then And Now"

impacts

concept: Industrial societies have a greater impact on the environment than do agrarian societies.

objective: Given the opportunity to compare pictures, the student will be able to describe the changes that have occurred from the past to the present in household chores and activities (i.e., cooking, lighting, sewing, etc.).

time: 2-3 45 minute class periods

subject matter area: Social Studies, Language Arts

grade: 7-9

implementation:

Activity:

1. Present the class with copies of pictures from Pioneer times in the United States.
2. Have the students list the chores and activities depicted in the pictures.
3. Have the students compare their lists with the chores and activities which occurr in present day American homes.
4. Discuss the changes which have occurred in relation to their impact on the environment. (i.e. changes in energy and resource use)

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to compare jobs from past American society with present day job opportunities, the student will be able to indicate the implications this type of change has on their future career choices and opportunities.

materials:

Pictures of the interior of a pioneer home (enough for one per student).

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to compare pictures of pioneer and present home life, the student will be able to record a list of changes which have occurred in household chores and activities, and relate these changes to their impact on the environment.

Developed by: Merodee L. Smith
Beaverton School Dist.
Beaverton, OR
Revised by: Duane K. Altig

activity no. 9

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title: "A Land Use Attitude Survey"

impacts

concept: Industrial societies have a greater impact on the environment than do agrarian societies.

objective: Given the opportunity to review a sample survey, the student will be able to construct and administer an attitude survey about land use.

time: 7-8 45 minute class periods

subject matter area: Social Science, Language Arts, Science

grade: 8-9

implementation:

Activity:

1. Give the students the Site Selection Pictures and the Record Form.
2. Play the tape recording for the students. (Or allow the students to play and listen to the recording separately.)
3. Have the students carry out the survey and write out their impression of the survey results.
4. Have the students construct and administer their own survey, one related to questions which evolve from the original survey. This activity could be done by groups of 2-3 students.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to complete the necessary research, the student will be able to participate in a panel discussion on the changes which have occurred in occupational opportunities in industry and farming from 1900 to the present.

materials:

One tape recording per class.
One record form per student.
One set of Site Selection Pictures per student or pair of students.
Plastic covering for each set of Site Selection Pictures.

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to obtain the necessary background knowledge, the student will be able to construct and administer their own attitude survey about land use.

Developed by: Robert M. Rice
Olympia, WA

Revised by: Duane K. Altig

activity no. 10

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Psychologists and sociologists often try to determine how a particular group of people sees or perceives an issue. They use a perception survey to accomphis this. There are five steps that these researchers follow. These are:

1. Define the group.
2. Define the issue.
3. Formulate questions.
4. Conduct a poll.
5. Analyze the results.

Let's look at these steps in a little more detail.

First, the researcher must define the group that he is going to survey. For example, is he interested in all the men in California; the teenagers in Salem, Oregon; the employees in one store; dog owners in one neighborhood; or sixth graders in one school? He must be very specific or he may find that he is wasting his time by talking to people who have not interest in the issue that he is examining.

Second, the researcher must carefully define the issue or trend that he is examining. For example, is he interested in what is the favorite food of sixth graders? Maybe he actually wants to know what dessert sixth graders favor or even more specifically he may want to know what is the favorite type of cake eaten by sixth graders.

The researchers third task is to formulate or write the questions that he will be asking. Simple, easily understood questions are less likely to confuse and give unreliable results.

Once the questions are formulated the researcher must conduct a poll. Here he goes out and asks his questions of the group that he is interested in. Sometimes the researcher interview people and sometimes he passes out questions in written form.

The researcher's last task is to collect his answered questions and analyze them. He must determine what the majority of people think about each question. He also has to sum up what the typical or average member of the group he has surveyed thinks about the total issue. The researcher is always cautious to remember that his survey is only true for the group that he surveyed on the date he did the poll. Another group or the same group on another date may feel quite differently.

Now that you have some background about perception surveys you will be asked to take a poll of a class of students in your school. The issue that you will be dealing with is the use of a particular site of land. Let's assume that your community has a forest site and several groups have ideas about what to do with it. You are going to find out what one of the classes in your school would like to see happen to the forest site.

Take the Site Selection Pictures and interview the members of the class you have chosen to survey. Show the pictures to each student and ask what their first, second, third, and so on choice would be. On the Record Form place a one under the student's first choice; and two under his second choice; and so on. Do this with each student in the class. When you have finished add up the numbers under each picture. The picture with the lowest score is the classes first choice; the picture with the next lowest score is their second choice; and so on. The survey will give you some idea about the classes perceptions about good land use. Notice where the solar thermal site picture was placed by this class. How can energy producers make solar sites more popular with the public? Was the solar site more or less popular than the

nuclear sites? What does this tell you about the public's choice of energy production methods?

When you have finished this survey try to construct one on your own. Consider another issue that solar energy may create such as: Will it be costly? Does it pollute? Will it hurt the wildlife?

You may replay this tape recording at anytime if you need to refresh your memory about any point. Also, call on your teacher for help and advice. He may show you some elementary statistics that you can do and also some sampling techniques that may be helpful. Good Luck!

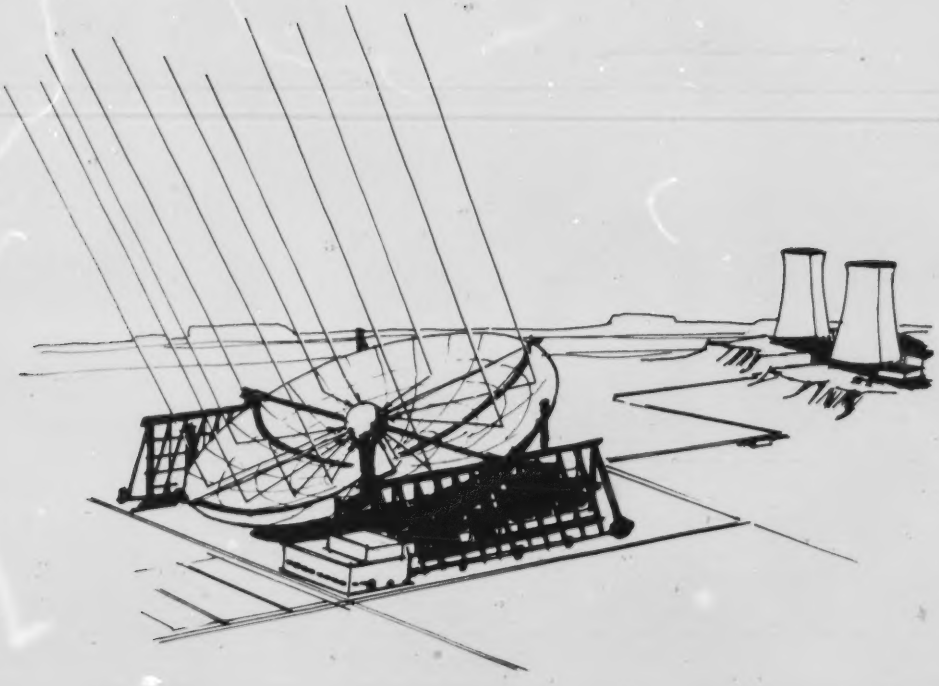
RECORD FORM

STUDENTS	PICTURES									
	Suburban	Urban	Solar	Cattle	Forest	Highway	Crop	Thermal Electric	Nuclear	Commercial

SITE SELECTION PICTURES

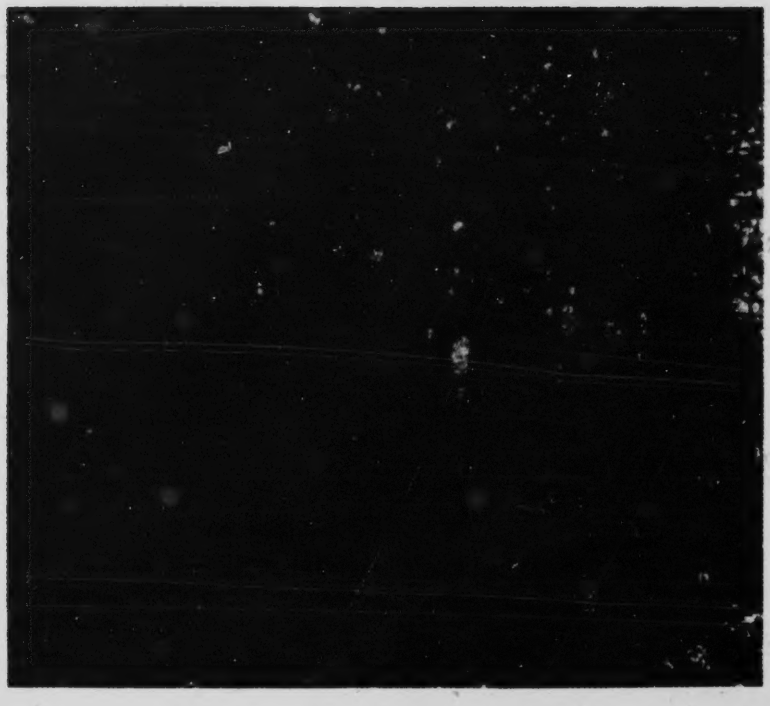
Urban Housing Site

Suburban Housing Site



Solar Thermal Collecting Site

Cattle Grazing Site



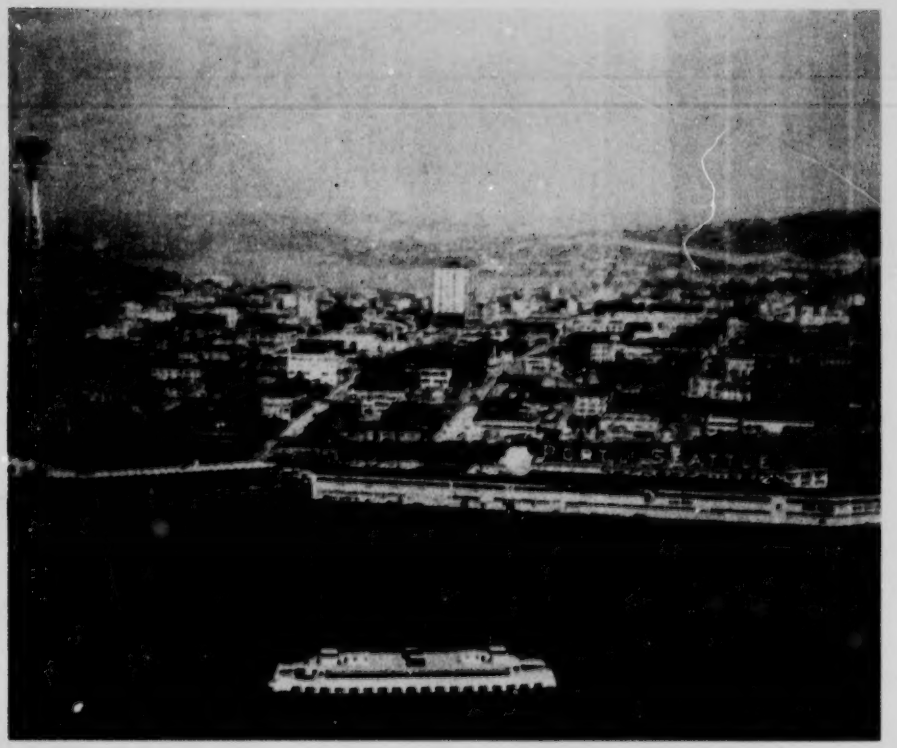
Forest Site

Crop Site

Highway Site

Thermal Electric Generation Site

Nuclear Generation Site



Commercial-Industrial Site

Photo Credits

Commercial-Industrial Site:
"NUclear Energy In Washington," Office of Nuclear Energy Development, Department of Commerce and Economic Development, Washington State.

Nuclear Generation Site:
Ibid.

Thermal Electic Generation Site:
Today's Education, January 1970.

Suburban Housing Site:
Erich Hartmann (Magnum).

Urban Housing Site:
Abraham S. Fischler, et al. Modern Elementary Science 6, Holt, Rinehart and Winston, Inc.

Forest Site:
Paul F. Brandwein, et al. Concepts in Science 3, Hartcourt, Brace and World, Inc.

Highway Site:
Abraham S. Fischler op. cit.

Cattle Grazing and Crop Sites:
Paul F. Brandwein op. cit.

Solar Thermal Collecting Site:
Power Generation Alternatives, Seattle City Light, Seattle, Washington.

LIMITS OF ENERGY

GOAL:

IT IS ESSENTIAL THAT EACH PERSON KNOW THAT THE EARTH'S RESOURCES ARE LIMITED.

ACTIVITY
DESCRIPTION PAGE

LIMITS (7-9)

Goal: It is essential that each person know that the Earth's resources are limited.

Concept: All sources of energy are limited; most can be [illegible] only once.

Activity #1 "Depleting Energy Sources"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to contemplate a depletion of energy sources, the student will be able to consider the implications of decreasing energy supplies.

Activity #2 "A Trip To 'New Earth'"
Grade level 8-9
All Subject Matter Areas

Given the opportunity to participate in a simulated spaceship journey, the student will be able to develop an awareness of what all humans must do to ensure the conservation of resources on earth and to ensure survival of all life.

Activity #3 "Conserving Natural Resources"
Grade level 9-10
Social Science, Consumer Education

Given the opportunity to identify natural resources, the student will be able to discuss the importance of conserving our storehouse of natural resources for the welfare of our economy.

Concept: Some energy sources are rapidly renewed while others are renewed so slowly as to be practically nonrenewable.

Activity #4 "Energy Demands and Fossil Fuels"
Grade level 8-10
Mathematics, Science, Social Science

Given the opportunity to construct a mobile, the student will be able to express the current dilemma of energy demand and the fossil fuel reserves.

Concept: Limitations may be viewed as relative to changing energy demands.

Activity #5 "The Energy Dilemma"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to design a bulletin board, the student will be able to express in graphic form, factors related to the energy dilemma.

Concept: Knowledge and technology help develop and extend past, present, and future energy resources.

Activity #6 "We're Out of Oil?"
Grade level 8-9
Social Science, Science

Given the opportunity to do individual research, the student will be able to understand that the amount of petroleum on earth is finite.

Concept: Population change directly influences energy use, availability and supply.

Activity #7 "People and Energy"
Grade level 7-9
Mathematics, Social Science

Given the opportunity to construct graphs, the student will be aware that the increasing growth of the world population influences the consumption of energy.

title: "Depleting Energy Sources"

limits

concept: All sources of energy are limited; most can be used only once.

objective: Given the opportunity to contemplate a depletion of energy sources, the student will be able to consider the implications of decreasing energy supplies.

time: 1 - 45 minute class period

subject matter area: All

grade: 7-9

implementation:

Activity: 1. Describe to the students a situation wherein all energy sources were gradually being depleted. Ask each student to list ten or twenty activities which would change or cease under such circumstances. Bring class together for a discussion of their lists. Have papers turned in.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to research the required energy sources used in an occupation of their interest, the student will be able to describe the effect on that occupation of a total loss of the required energy source.

materials:

SUGGESTED ASSESSMENT PROCEDURE"

Given the opportunity to contemplate the depletion of energy sources, the student will be able to list a number of activities which would change or cease.

Developed by: Merodee L. Smith
Beaverton School Dist.
Beaverton, OR

activity no. 1

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title: "A Trip To 'New Earth'"

limits

concept: All sources of energy are limited; most can be used only once.

objective: Given the opportunity to participate in a simulated spaceship journey, the student will be able to develop an awareness of what all humans must do to ensure the conservation of resources on Earth and to ensure survival of all life.

time: 5-7 45 minute class periods

subject matter area: All

grade: 8-9

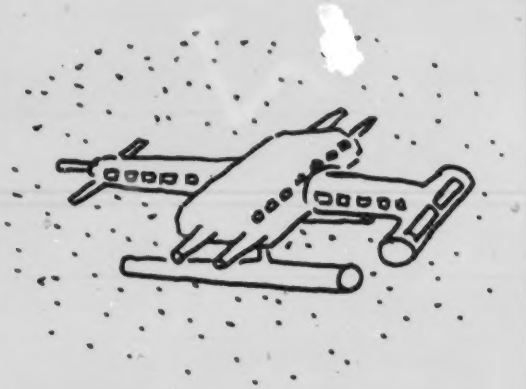
implementation:

Activity:

1. Introductory statement: Because the Earth will not be habitable soon, due to various human activities, (war, pollution...). Your crew (group) of two girls and two boys has been chosen to make an exploratory visit to another planet. The closest, most suitable "New Earth" is in another solar system and will require 20 years of travel to reach with present spaceship technology.
   a. Your crew will never return to Earth but will set up initial colonization of the planet in preparation for future arrivals from Earth. You will also be expected to formulate guidelines to assure that the same disaster (see above) does not occur on "New Earth."
   b. Your spaceship can only carry, supply, or produce enough space, oxygen, water, and food for eight persons for 15 years. You may take 100 pounds of cargo per person in addition.
   c. Have students speculate on the size, shape, and general construction of the spaceship.

materials:

Pencils and paper.
Various items from home (100 lb. cargo per person).
Poster paper and magic markers.
Large models of Earth, a spaceship, and "New Earth."
Student clothes
Extra materials requested by students.



activity no. 2

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implementation:

materials:

Activities (continued)

2. Day 1: List the equipment you would take with you (100 lbs. per person) in order of importance. (For each item give name, weight, and use or reason for taking.) Use slides or taped music from Earth during day 1.

3. Day 2: Come to class dressed for the voyage.
   a. Bring samples to class and/or pictures of the items listed the first day.
   b. Make a list of rules necessary for survival to be established aboard ship.

4. Day 3: Have students develop a list of problems which might arise during the journey.
   a. Identify eight or ten of the most interesting problems and list possible solutions to the problems.
   b. Teacher may wish to direct the discussion to include some or all of the following:
      1. How could a population of eight people (present group and births) survive the journey on 15 years' worth of resources? (Hint: What equipment would you take as cargo to produce resources?)
      2. What do you think will happen if five children are born in the twenty years? Why?
      3. What if salt is accidently poured in the fresh water supply?
      4. What if a fire contaminates the air supply?
      5. What will be done about wastes? Why?
      6. What other problems are possible aboard the spaceship? Why? Possible solutions? (Hint: Getting along with each other, etc.)

Implementation:

Activities: (continued)

5. Day 4: List as many rules for survival as you can that you would establish on the "New Earth" to insure indefinite well-being and quality of life on the planet.
   a. What other living things besides humans would you like to have on "New Earth?" Why?
   b. What other living things would be necessary for your survival on the new planet? Why?
   c. Draw and color three posters' scenes: One aboard ship, another of "Old Earth," another of "New Earth."

6. Day 5: Summary questions (class discussion).
   a. In what ways is our Earth a spaceship?
      - How is our Earth like your spaceship? How is it different?
      - Will the same rules for survival on the spaceship be necessary and work on Earth? Why or why not?
   b. Groups orally present week's work to class.
   c. Summary discussion of week's work, value, and applications to real life situations by entire class.
   d. Slides and taped music (Earth).

SUGGESTED CAREER EDUCATION ACTIVITY:

Given an opportunity to list the skills necessary for a spaceship journey, the student will be able to identify occupations which most closely match the needed skills and to identify the basic skills and attitudes which are necessary for all members of the spaceship crew.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to participate in a simulated spaceship journey, the student will be able to participate in a classroom discussion which relates the simulated activity to real life situations.

Developed by: David A. Adams
Cache School District
Wellsville, UT

Revised by: Duane K. Altig
Parkrose School District

title: "Conserving Natural Resources"

limits

concept: All sources of energy are limited; most can be used only once.

objective: Given the opportunity to identify natural resources, the student will be able to discuss the importance of conserving our storehouse of natural resources for the welfare of our economy.

time: 3-4 45 minute class periods

subject matter area: Social Science, Consumer Education

activity no. 3

implementation:

Activity:

1. Conduct a general class discussion on the following questions:
   a. What are our natural resources?
   b. What natural resources are non-renewable?

2. Divide the class into small groups. Have them identify and locate on a world map the resources needed to make an automobile.
   - Iron from Minnesota, Venezuela.
   - Nickel from Canada.
   - Copper from Montana.
   - Tin from Malaya.
   - Cellulose for plastic seat covers from Oregon.
   - Coal for heat and energy from Pennsylvania.

3. Have the groups identify which resources are non-renewable.

4. Have each group figure out their total share of raw materials in a lifetime (70 years) based on the following table:

materials:

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implementation:

Activities: (continued)

14000	lbs.	- Fuel and heat materials
10000		- Building materials
1600		- Food
5000		- Ore
4100		- Other agricultural products
800		- Other
35500	lbs.	- Natural resources per person per year in the U.S.

5. Discussion: (Entire class)
   a. U. S. has 6% of world's population and we use over 1/2 of all raw materials in the world. We need 29 minerals and we import 18. This makes what happens in Malaya very important.
   b. As world populations increase and higher standards of living develop, it becomes vital to practice conservation of natural resources.
   c. Discuss local resource problems such as tourism, urbanization, air and water pollution effects, zoning and planning.

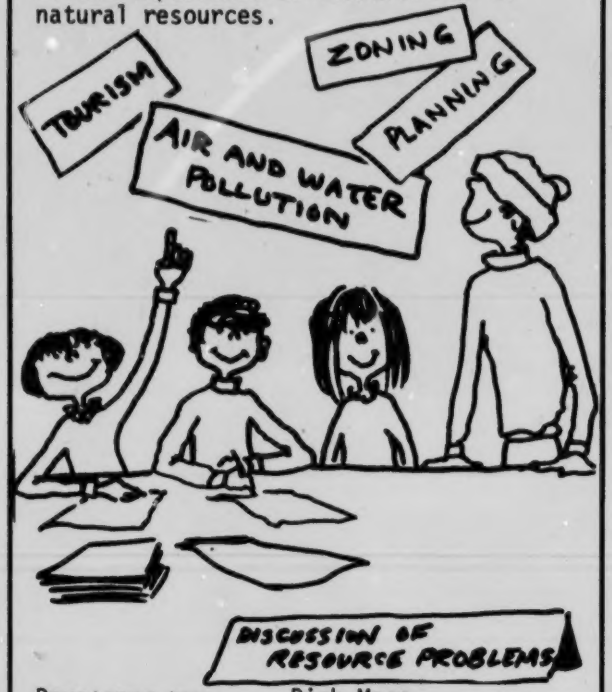
SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to participate in a class discussion, the student will be able to discuss how the use of natural resources in our economy affects jobs and job opportunities.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given an opportunity to identify the value of the world's resources to the welfare of our economy, the student will be able to participate in a discussion of the importance of conservation of natural resources.



Developed by: Dick Mace
Beaverton School Dist.
Beaverton, OR

Revised by: Duane K. Altig

title: "Energy Demands and Fossil Fuels"

limits

concept: Some energy sources are rapidly renewed while others are renewed so slowly as to be practically nonrenewable.

objective: Given the opportunity to construct a mobile, the student will be able to express the current dilemma of energy demand and the fossil fuel reserves.

time: 1-2 45 minute class periods

subject matter area: Mathematics, Science Social Science

grade: 8-10

implementation:

Activity:

1. The student will construct a mobile using the word ENERGY as the main balance arm. Divide the "load" which it supports into two subsets, fossil fuels and uses of fossil fuels. Each fuels unit will indicate the current output of the fuel source and by color coding the unit will indicate how much, if any, will be available in 2000 A.D. Each "use" or conversion will indicate the present rate of consumption and by color coding and perhaps by dimension will indicate the increased demand by 2000 A.D. based on available data from reliable sources.

2. Your library will provide you with current encyclopedias: also use the "energy" heading in the card catalog.

SUGGESTED CAREER EDUCATION ACTIVITY:

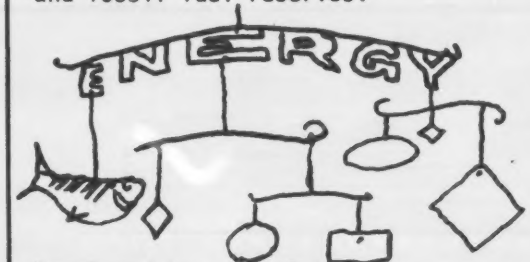
Given the opportunity to identify uses of fossil fuels, the student will be able to identify at least three occupations for each of the uses of fossil fuels.

materials:

Tagboard, wire, fishline, etc.
Energy in the World of the Future, Hal Helman, Publisher, M. Evans & Company, Inc., New York, New York

SUGGESTED ASSESSMENT PROCEDURE:

Given an opportunity to construct a mobile, the student will be able to recognize the dilemma of energy demand and fossil fuel reserves.



Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

activity no. 4

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title: "The Energy Dilemma"

limits

concept: Limitations may be viewed as relative to changing energy demands.

objective: Given the opportunity to design a bulletin board, the student will be able to express in graphic form, factors related to the energy dilemma.

time: Variable

subject matter area: All

grade: 7-9

implementation:

Activity:

1. The student will design a bulletin board considering the energy dilemma and such factors as:

Environmental Impacts	Trade-offs
Transportation	Industrial sites
Industrial pollution	Sources
Uses	Limits
Ecosystems	Future, etc.

2. Prerequisite for planning design: Student should be informed about energy problems and possible alternatives through the sources available to the classroom such as films, filmstrips, brochures, magazine articles, newspaper articles, books, lectures, etc.

3. Note to teacher: Prepared lists of specific materials available to the student should be issued by the teacher. Lists should be kept current as a ready resource for all energy related activities.

materials:

Art paper
Scissors
Cartons
Magazines
Cartoons
Other

activity no. 5

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implementation:

SUGGESTED CAREER EDUCATION ACTIVITY:

Given an opportunity to select occupations from a bulletin board display on the energy dilemma, the student will be able to identify all the occupations that require similar basic skills.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to construct a bulletin board display, the student will be able to graphically express factors related to the energy dilemma.

Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

title: "We're Out Of Oil?"

limits

concept: Knowledge and technology help develop and extend past, present and future energy resources.

objective: Given the opportunity to do individual research, the student will be able to understand that the amount of petroleum on earth is finite.

time: 3-4 45 minute class periods

subject matter area: Social Science, Science

grade: 8-9

implementation:

Activity:

1. Have the students do independent research to determine the estimated amount of petroleum reserves for the world. (May still look infinite to student.)
2. Through class discussion and available resource materials determine usage level per person, adding in the projected increase in population.
3. Divide students into groups. With the information found on the amount per person available and a chart on amount of petroleum used for different individual needs (such as light, heat, food, etc.) each group should be given grains of wheat representing a certain number of barrels of oil. Let them determine the time that the reserves would last at our present use.

materials:

Petroleum research papers and materials.
Sack of wheat.
Overhead transparencies of usage of petroleum, amounts available and possible, and depletion curve, for post lab discussion.

activity no. 6

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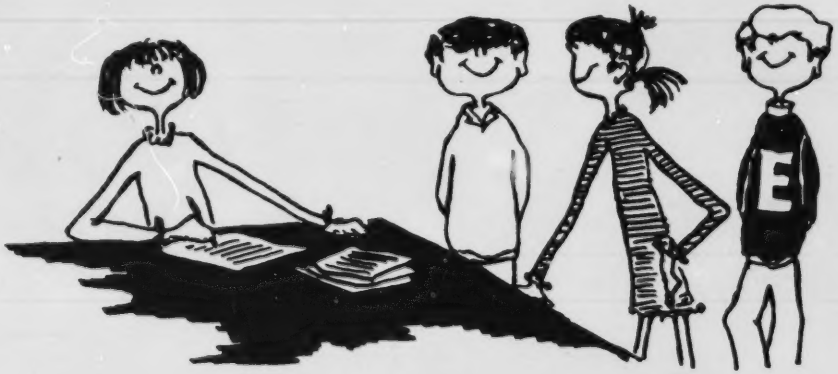
implementation:

Activities: 4. Also talk about possibilities of increased usage per person, conservative uses, and time limitations.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify a situation of no petroleum energy source, the student will be able to, through classroom discussion, understand the role of government in providing for the employment problems created by the situation.



materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to do individual research, the student will be able to, through small and large group discussions, understand that the amount of petroleum is finite.

Developed by: Bob Rindlisbacher
Granite School District
UT

title: "People and Energy"

limits

concept: Population change directly influences energy use, availability and supply.

objective: Given the opportunity to construct graphs, the student will be aware that the increasing growth of the world population influences the consumption of energy.

time: 1-2 45 minute class periods

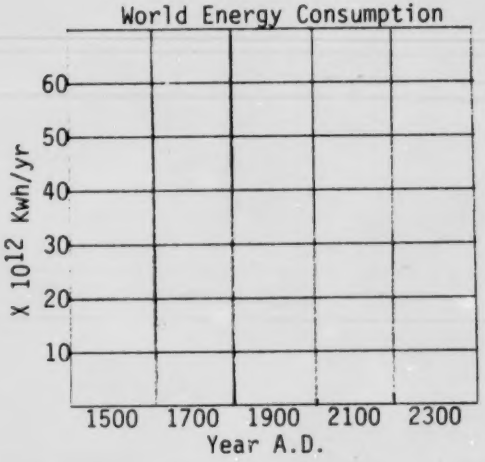
subject matter area: Social Science, Mathematics

grade: 7-9

implementation:

Activity: 1. Plot the following data on a graph:

Year	Energy in Kwh/yr
1500 A.D.	2×10^{12}
1750 A.D.	6×10^{12}
1900 A.D.	16×10^{12}
2050 A.D.	48×10^{12}
2160 A.D.	50×10^{12}



materials:

Graph paper

activity no. 7

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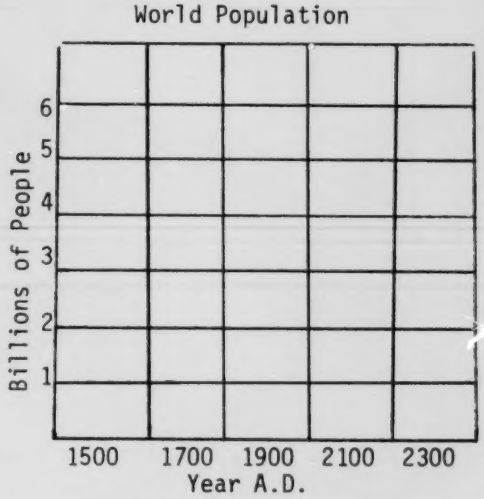
implementation:

Activities: (continued)

2. Note: The short form for writing 1,000,000,000,000 is 10^{12}. In other words 10 multiplied by 10 twelve times. 1,000 is 10^3 or 10 multiplied by itself three times.

3. Plot the following data on a graph:

Year	World Population (Billions of People)
1500 A.D.	.4
1750 A.D.	.75
1900 A.D.	1.90
2050 A.D.	6.50
2160 A.D.	7.00



4. What information can you extract from this curve?

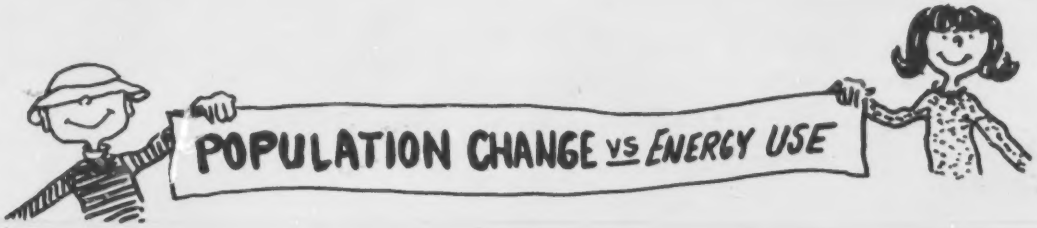
materials:

implementation:

Activities: 5. Discuss the conditions that develop from such evidence. How could this development affect you by the time you are your parents' age? Do you as a citizen have any part in controlling or helping control those future conditions? How could you or anyone best be effective?

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to discuss the implications of an increasing world population, the student will be able to relate in writing how an increasing world population would influence the student's future job market opportunities.



materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to construct graphs related to world population and energy consumption, the student will be able to understand the influence of increasing world population on the consumption of energy.

Developed by: Mabel Lund
Beaverton School Dist.
Beaverton, OR

FUTURE SOURCES OF ENERGY

GOAL:

IT IS ESSENTIAL THAT EACH PERSON KNOW THAT NEW ENERGY SOURCES AND MORE EFFICIENT SYSTEMS, ACCOMPANIED BY DIFFERENT CONSUMPTION PRACTICES, MAY ALTER THE WORLD ENERGY DILEMMA.

ACTIVITY
DESCRIPTION PAGE
FUTURE (7-9)

Goal: It is essential that each person know that new energy sources and more efficient systems, accompanied by different consumption practices, may alter the world energy dilemma.

Concept: New energy technology may be developed in the future.

Activity #1 "Solar Radiation"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to identify high solar radiation areas of the U.S., the student will be able to recognize solar radiation as a potential answer to energy needs.

Activity #2 "Nuclear Reactors - A New Language"
Grade level 7-9
Science

Given the opportunity to read a packet on nuclear fission, the student will be able to demonstrate a knowledge of the terminology relating to nuclear reactors.

Concept: Future energy technologies will be judged by their combined economic, social, political, technical, and environmental impacts.

Activity #3 "Nuclear Plant Locations"
Grade level 8-10
All Subject Matter Areas

Given the opportunity to gather the necessary information, the student will be able to demonstrate an understanding of nuclear plant locations and the increasing number of reactors.

Activity #4 "Dispose or Recycle?"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to identify disposable items, the student will be able to identify the significance and possibilities of recycling.

Concept: Energy availability will affect future life-styles and cultural conditions.

Activity #5 "Power Consumption At Home"
Grade level 7-9
Mathematics, Science

Given the opportunity to complete a learning activity package, the student will be able to relate the results of possible electrical power consumption changes in a private residence.

Activity #6 "A Change In Vacation Plans"
Grade level 7-9
Social Science, Language Arts

Given the opportunity to plan an "ideal" vacation, the student will be able to identify the effects of a loss of energy sources on their lifestyles.

Concept: Future energy development will require new job skills.

Activity #7 "Jobs In The Future"
Grade level 7-9
All Subject Matter Areas

Given the opportunity to listen to interviews, the student will be able to identify the necessary skills that will be required of future energy-related occupations.

title: "Solar Radiation?"

future ?

concept: New energy technology may be developed in the future.

objective: Given the opportunity to identify high solar radiation areas of the U. S., the student will be able to recognize solar radiation as a potential answer to energy needs.

time: 1-3 45 minute class periods

subject matter area: All

grade: 7-9

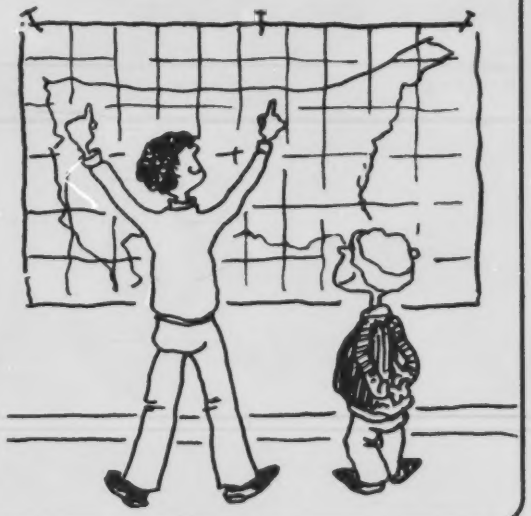
implementation:

Activity:

1. Using a clearly detailed physical map of the United States, ask the students to perform the following functions:
   a. Identify those sections of the United States which would experience great amounts of solar radiation with the least deflection because of the topography, weather conditions and air pollution.
   b. Identify the municipalities of about 10,000 in those sections on the map.
2. Inform the students that the per capita consumption of electricity for the United States in 1971 was 10 KW.
3. As a point of information tell the students that Arden P. Meinel and Marjorie Meinel of the University of Arizona have been leaders of a research group studying solar radiation as a source of energy. The system used by this team would require approximately 35 square kilometers for collecting and converting sufficient energy to produce 1000 megawatts. Their model would operate at nearly 30 per cent efficiency. This is comparable to the system of another research team both in output and required space.

materials:

Map of the United States. (if a wall map is available, the student will be able to make assessments with greater accuracy.



activity no. 1

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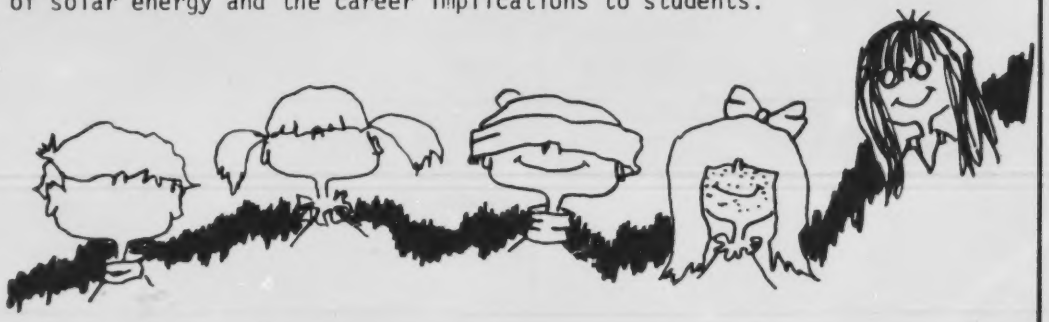
implementation:

Activities: (continued)

4. Using the information now at hand, plus any additional research that may have been done, have the students answer the following questions:
   a. Approximately how many people are possible patrons of electrical service from power plants in areas you identified on the map?
   b. How many solar systems (farms) could be erected in the identified areas using the requirements of Meinel's research group?
   c. Based on the output stated, how many people could be supplied with the electricity provided by the farms you decided could be built in these areas?
   d. What kind of land would be used by these farms? Would these eliminate food-producing space?
   e. Considering the answers to the questions above, do you feel solar farms may be a partial answer to the energy dilemma?

SUGGESTED CAREER EDUCATION ACTIVITY:

Given an opportunity to invite a solar energy resource person to visit the class, the student will be able to listen to a talk about the future of solar energy and the career implications to students.



materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the necessary background knowledge, the student will be able to write a discussion of the advantages and disadvantages of solar energy as an answer to the energy dilemma.

Developed by: Mabel Lund
Beaverton School Dist
Beaverton, OR

Revised by: Duane K. Altig

title: "Nuclear Reactors - A New Language"

future ?

concept: New energy technology may be developed in the future.

objective: Given the opportunity to read a packet on nuclear fission, the student will be able to demonstrate a knowledge of the terminology relating to nuclear reactors.

time: 2 - 45 minute class periods

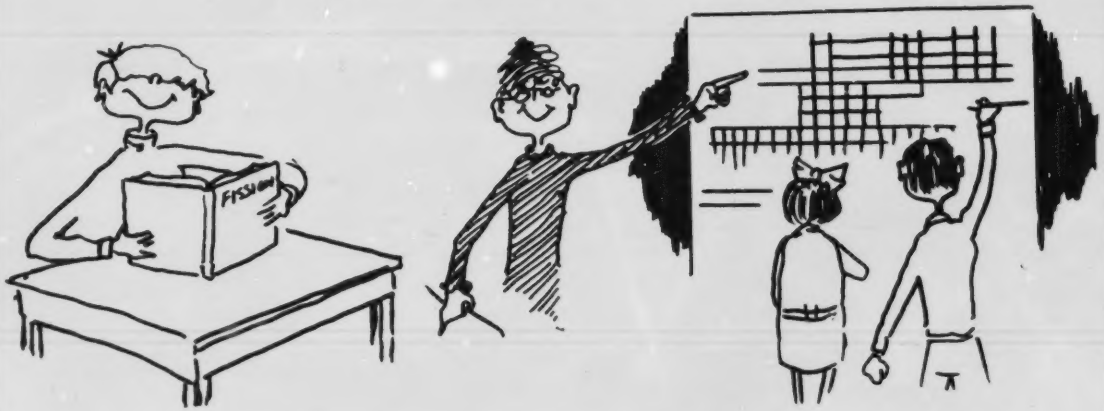
subject matter area: Science

grade: 7-9

implementation:

Activity:

1. Students read packet on fission.
2. Teacher discusses information in packet.
3. Students do crossword puzzle.
4. The teacher will correct the crossword puzzle and discuss the answers with the students.



materials:

Vickery, Gordon, Power Generation Alternatives, Seattle City Light, 1975, $5.00

Inglis, David R., Nuclear Energy - Its Physics and Its Social Challenge, Addison-Wesley Publishing Company Inc., 1973.

Project Physics, The Nucleus, Holt, Reinhart and Winston Inc., Distributors, 1968.

One learning packet on fission.

References:

Wilson, Richard and Jones William, Energy, Ecology and the Environment, Academic Press, 1974.

activity no. 2

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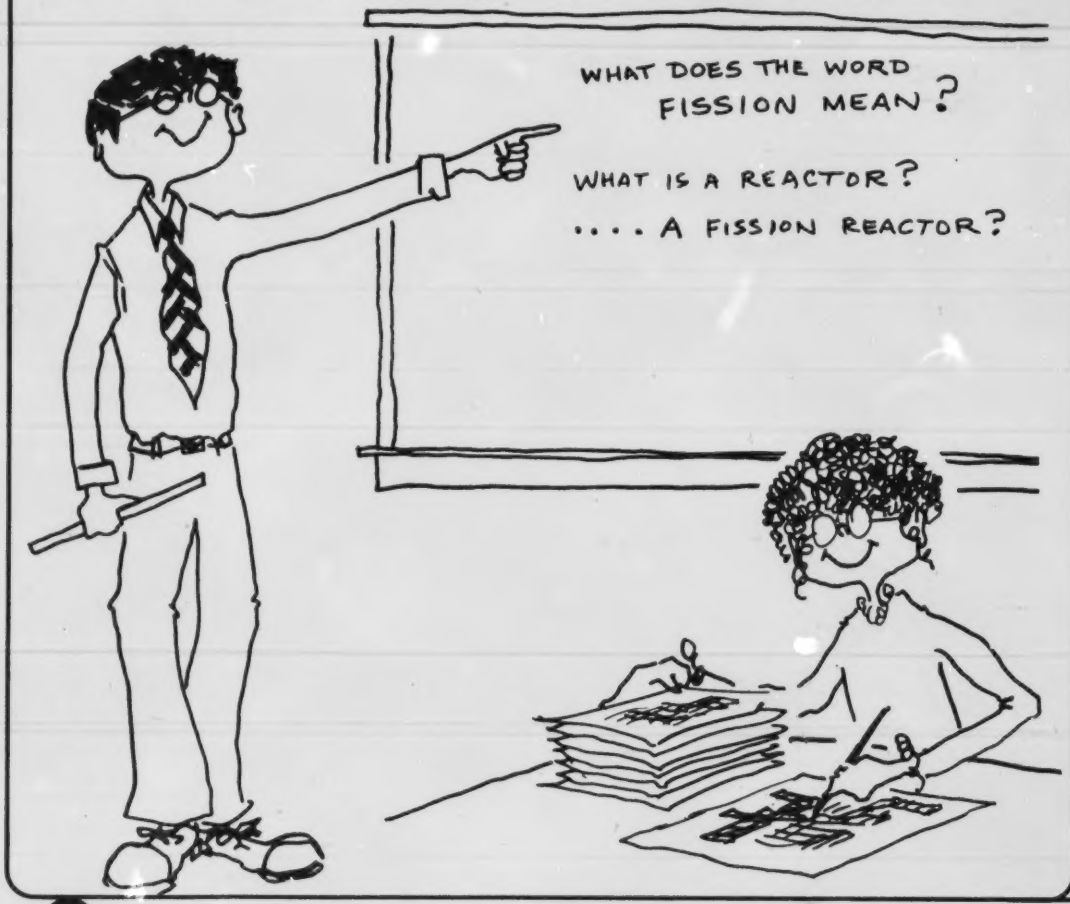
implementation:

SUGGESTED CAREER EDUCATION ACTIVITIES:

Given the opportunity to invite a local resource person or take a field trip to a nearby nuclear reactor plant, the student will be able to make lists of all the occupations they view or which were mentioned?



materials:

See The New Yorker magazine, December 10, 1973, page 105-106.

Teachers could contact their local utility company for additional information about fission reactors.

SUGGESTED ASSESSMENT PROCEDURE:

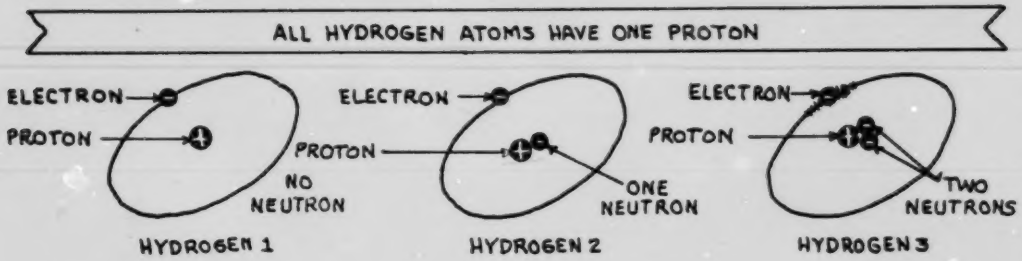
Given the opportunity to read an article related to nuclear fission reactors, the student will be able to complete a crossword puzzle of fission reactor terminology.

Developed by: Tom Schultz
Everett School Dist.
Everett, WA

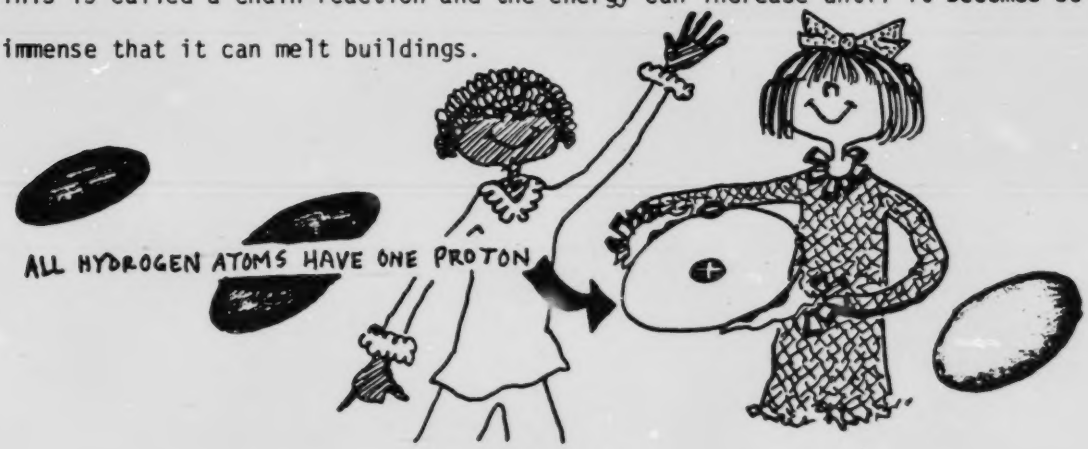
Revised by: Duane K. Altig

Introduction:

Electrons, protons and neutrons make up a simple model of an atom. The protons and neutrons reside in the center (the nucleus) and the electrons surround the nucleus.

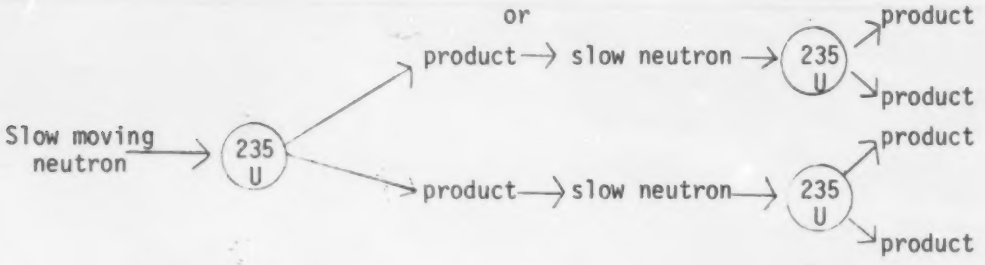


Different atoms have different numbers of protons. The protons are positively charged and respond to each other like similar ends of bar magnets. When we experiment with two bar magnets we find that the opposite ends attract each other and bringing the like ends together, the magnets repel. (Demonstrate) How come then the protons in the nucleus don't repel? They try to, but there is a fantastic binding force present in the nucleus holding the protons together. This force overcomes the repulsion. The force, or energy, is released by splitting the nucleus, a process called fission. When a neutron is absorbed by a large nucleus, such as uranium, other neutrons are given off, which in turn split other nuclei. This is called a chain reaction and the energy can increase until it becomes so immense that it can melt buildings.



Chain Reaction Diagram

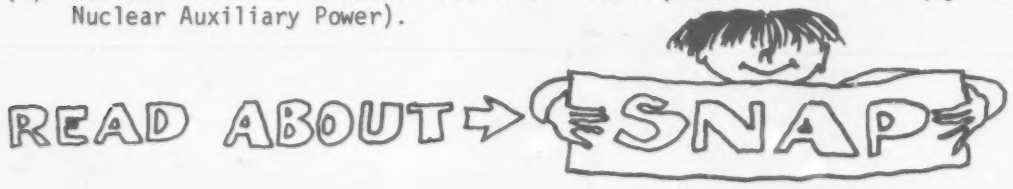
Neutron + Uranium - 235 $\xrightarrow{\text{Fission Power}}$ (Fission Products) + (Neutrons) + (Heat)

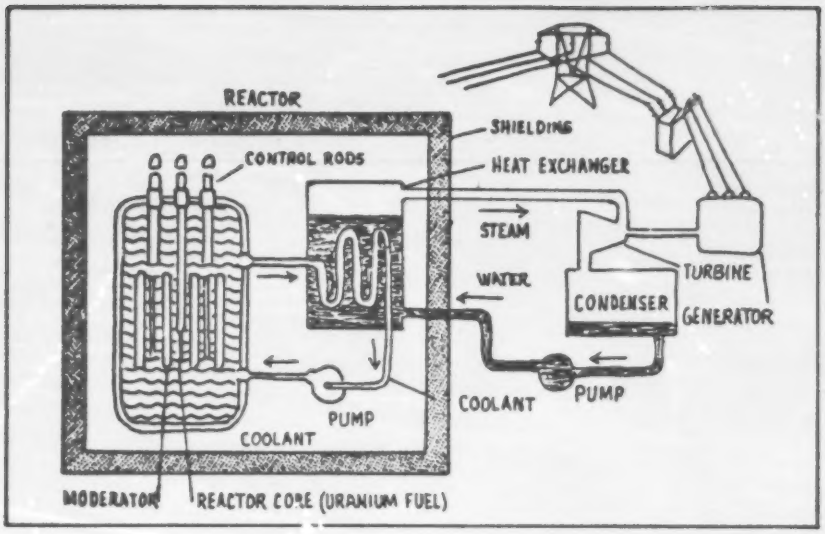


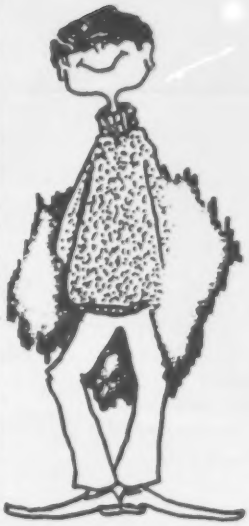
When this energy is harnessed we have nuclear power. Ships and electrical power plants have successfully used this energy of the nucleus since the 1950's. The operation and generating facilities of a nuclear power plant is not much different from a conventional coal burning power plant.

Boilers, turbines, generators and electrical switch gear are common to both the conventional power plant utilizing fossil fuels and the power plant using nuclear fuels. The heat exchanger (boiler) is where heat from the nuclear reaction changes water into steam. The steam is then transported via pipes where it then enters the turbine and turns blades which turn the generator to produce electricity. The electricity then goes to the electrical switch gear where the voltage and currents are regulated for the transmission. It is conceivable that some day electricity will be produced directly from a reaction of atoms in an atomic furnace. Should this ever happen, there would be no need for boilers, turbines, and generators. This is now done for systems which produce a small current of electricity for a very long time without recharging.(1)

(1) For additional information read about heart pacemakers or SNAP (Systems for Nuclear Auxiliary Power).







Nuclear Reactor

A reactor is a piece of equipment or pressure tank designed to contain chemical reactions. A nuclear reactor is one in which reactions within the nuclei of atoms occur in a self-sustaining or chain-reacting manner. This process is called fission.

There are essentially five main components in a reactor vessel. The first is fuel, Uranium-235, introduced as a small part of the tons(1) of normal uranium (U-238) in the reactor. The uranium fuel is in cylinders about 1 cm long and these slugs are in long rods. These fuel rods are in the reactor core.

Second, a moderator must be used to slow down the neutrons given off by the uranium during fission so the chain reaction can continue efficiently. The moderator is usually a material having lightweight atoms which the neutrons can hit, thereby losing part of their energy. Two of the best moderators are carbon (graphite) and heavy (D_2O) and light (H_2O) water.

(1) Portland General Electric's Trojan plant at Rainier, Oregon, uses 95 tons of fuel. Approximately 3% of the fuel is enriched Uranium-235. One-third of the fuel will be replaced every year.

The third component is the control and safety rod mechanism for control of the reaction. If the chain reaction were allowed to continue uncontrolled the reactor would eventually melt. Atoms of some materials have the ability to capture and hold free neutrons. If such a material in the form of rods is inserted into the nuclear reaction, it can completely stop the chain reaction. Boron and cadmium are effective materials for neutron capture. Rods containing either of these can be moved in and out of the reactor vessel to allow the nuclear reaction to progress at the desired level.

The fourth component is the coolant. Some reactors are cooled by air, some by water and others by liquid-metal compounds and other fluids. The coolant's purpose is to carry away the heat produced in the fuel. This keeps the reactor at sufficiently low temperature to avoid heat damage to the reactor or generation gear and transfers the heat to where it can be used.

The fifth component is shielding. When a reactor is operating, many radioactive particles are given off. Those which are not absorbed by the moderator or coolant are retained in shielding walls of iron and concrete several feet thick (see diagram). The shielding walls contain portholes which give access to the reactor for checking and maintaining the reactor core.

Heat Exchanger

A heat exchanger is a device which transfers heat from one substance to another. For example, a refrigerator is a heat exchanger. In a simplified way the heat inside the refrigerator is transfered to a gas which flows through coils of a metal tube and is then pumped outside the refrigerator where it is cooled by a fan. The cooled gas is then pumped back into the refrigerator where it absorbs more heat to be carried back out and cooled. This is a continuous cycle that occurs until the refrigerator is turned off.

The heat exchanger in a nuclear power plant works similarly. The nuclear pile is cooled by water or sometimes liquid sodium. This coolant becomes radioactive and in order to safely use its heat energy, the heat must be exchanged with a substance that is not radioactive in a heat exchanger. Since radioactive coolant and the nonradioactive water are in different pipes, the radioactivity does not leave the reactor; just the heat energy. The water then transfers the energy to the steam turbine. The water, which is now a gas, turns fans in the turbine, is collected, condensed in large condensing towers, and is returned again to the heat exchanger to collect more energy. The turbine turns the generator to produce electricity.

Nuclear Reactor and the Environment

Although a nuclear reactor does not create smoke, fly ash, or sulfur dioxide, it produces three kinds of radioactive pollutants: solid, liquid and gas. The radioisotope decay rate may be rapid or may extend over thousands of years. Solid wastes may consist of such items as clothing, reactor parts, tools, spent fuel and control rods. These wastes are generally buried in drums of cement below the earth's surface, where no appreciable radiation is detected.

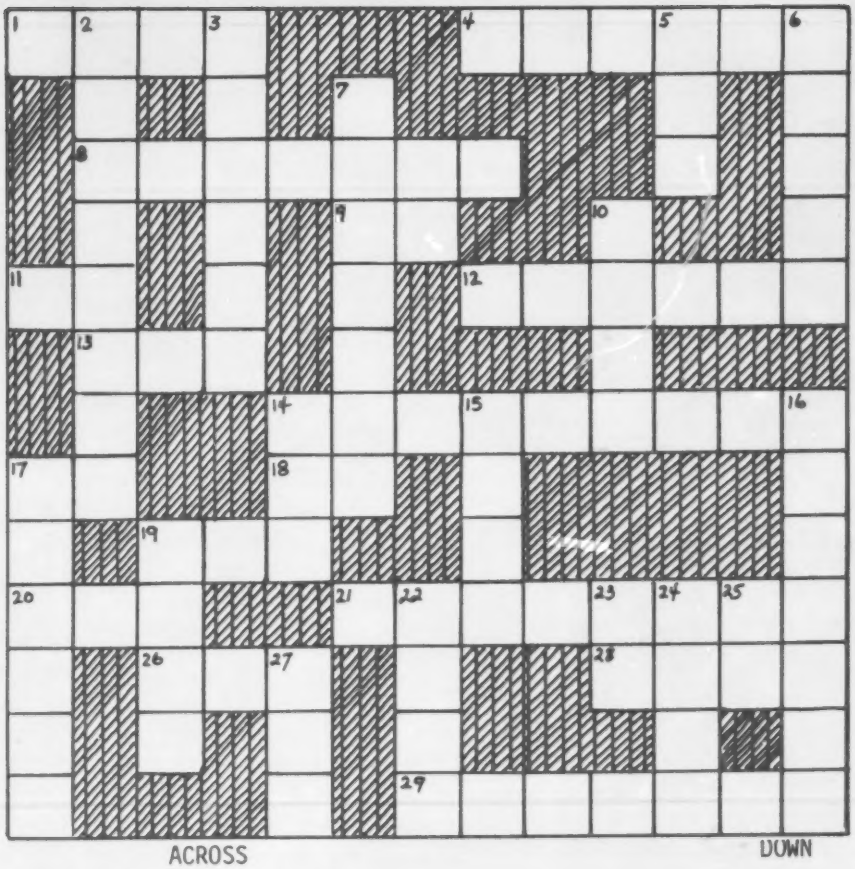
Some liquid wastes possess low-level radioactivity resulting from isotopes formed when impurities in the coolant are bomarded by neutrons inside the reactor. Since these wastes are so low in radioactivity they are usually discharged directly into the environment. If the radioactivity is too high the liquid waste is concentrated by evaporation, then blended with concrete and placed in steel drums.

The gaseous radioactive waste comes in the form of krypton-85, xenon, tritium (another isotope of hydrogen) and iodine-131. These fission products are of a low level nature when dispersed into our air environment.

Thermal wastes have been of considerable public concern because of fear that the amount of heat being released in the production and consumption of energy will affect the natural thermal balance of Earth. Not only is there concern for the quality of life, but if the global temperature were to increase disastrous effects such as melting of the ice caps might occur.

In summary we note that we trade off the hazards of fission--radiation and excess heat--for the opportunity to make electricity.

FISSION CROSSWORD PUZZLE

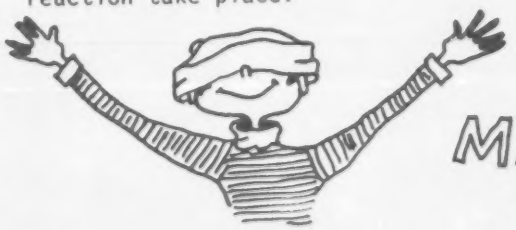


ACROSS

1. a particle that contains protons, neutrons and electrons
4. a power station contains a reactor ____
8. the ropes of a sailing ship
9. another word that sounds like sew
11. Spanish for yes
12. one of the things we get from splitting the nucleus
13. a fruit in a shell
14. a word meaning dirty or contaminating
17. a simple verb
18. opposite of off
19. the warmth of a nuclear reaction
20. John _____
21. a type of reaction
26. a past tense of the verb eat
28. to carry
29. in a nuclear reaction, where does the reaction take place?

DOWN

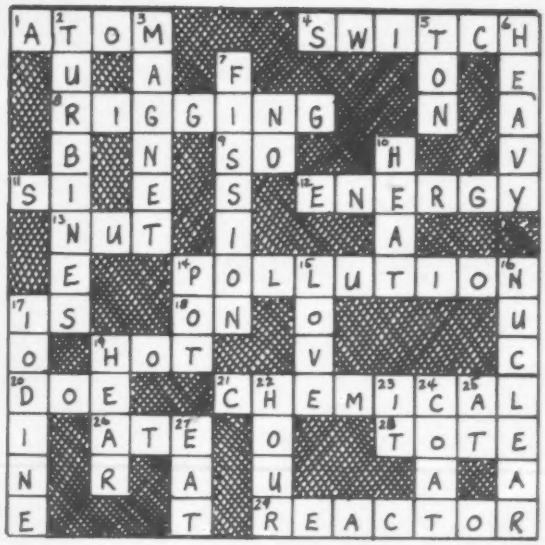
2. a piece of equipment that generates electricity
3. a piece of iron that has north & south poles
5. two thousand pounds
6. something that weighs a lot
7. the name of the process of splitting the nucleus
10. a form of energy a nuclear reactor produces
14. similar to a pan
15. opposite of hate
16. the fission process occurs in
17. a radioactive substance emitted
19. a word that sounds like here
22. sixty minutes
23. a pronoun
24. something you wear to keep you warm
25. in a certain place
27. consumption of food



MADE IT!!!!

activities

CROSSWORD PUZZLE ANSWERS



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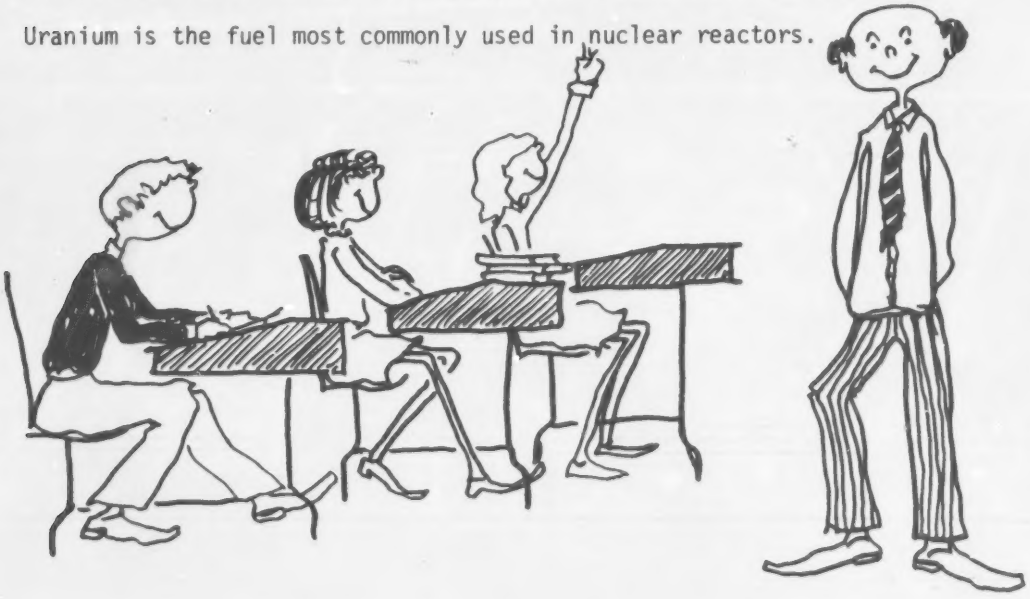
ORAL QUESTIONS ON FISSION

1. What are the particles in the nucleus?
2. What is the function of rods containing the atoms boron and cadmium in a nuclear reactor?
3. How do heat exchangers bridge the gap between nuclear power and more conventional power?
4. What is the purpose of a coolant in the nuclear reactor?
5. What kind of waste comes from a nuclear reactor?
6. What is the fuel most commonly used in a nuclear reactor?

ANSWERS TO ORAL QUESTIONS ON FISSION

1. Protons and neutrons are the particles in a nucleus.
2. To speed up or slow down a nuclear reaction; they also keep the chain reaction from getting out of hand.
3. Heat exchangers transfer the heat from a radioactive substance to one which is non-radioactive.
4. To keep the reactor from overheating and to transfer the energy from the reactor to the heat exchanger.
5. Thermal waste and radioactive wastes come from nuclear reactors.
6. Uranium is the fuel most commonly used in nuclear reactors.



title: "Nuclear Plant Locations"

future ?

concept: Future energy technologies will be judged by their combined economic, social, political, technical and environmental impacts.

objective: Given the opportunity to gather the necessary information, the student will be able to demonstrate an understanding of nuclear plant locations and the need to increase the number of reactors.

time: 1 - 45 minute class period

subject matter area: All

grade: 10-12

implementation:

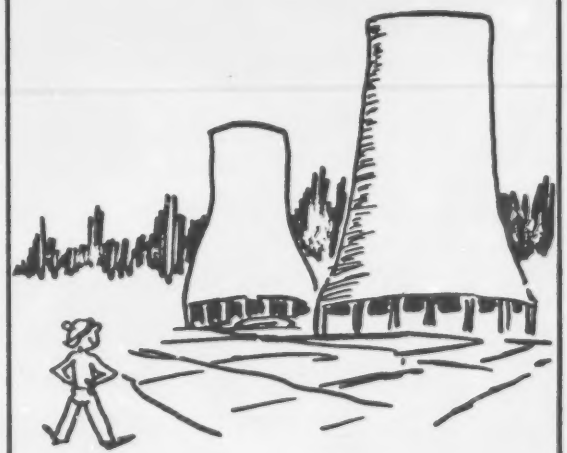
Activity:

1. Distribute copies of maps to each student.
2. Discuss maps with the class relative to symbols used and the relationships of the two maps.
3. The following questions may be used as discussion questions or as individual essay questions: ?
   a. Where are most of the existing and proposed nuclear plants located?
      - Which area of the United States?
      - Which state (s) has (have) the most?
   b. How many nuclear plants are already in existence and being operated as of 1978?
   c. What percentage of the total number of existing and prospective plants is this?
   d. What percentage of the total are plants which are being built?

materials:

Attached maps:

Location of nuclear plants.
Location of uranium sources.
Answers to questions (attached).



activity no. 3

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implementation:

Activities: (continued)

e. What percentage of the total are reactors in the planning stage?

f. What conclusions can you draw as far as the future trends of nuclear energy, using the percentages you figured out in "c," "d," and "e."

g. What reasons can you think of to explain why most of the nuclear plants are or will be located along the East Coast?

h. Look at the map showing the location of uranium sources. How does their location compare to the location of the nuclear plants?

i. Can you give any reasons why the location of the uranium is not the location of nuclear plants?

j. What percentage of the 1977 total electric utility capacity does the total number of nuclear kilowatts represent? How does this answer relate to your answer to "f."

Optional Activity: The students may also be given a quiz as follows:

1. Most nuclear plants are located:
   - In the Middle West.
   - In the South West.
   - On the East Coast.
   - On the West Coast.
2. Which of the following states has more nuclear plants than the other ones listed?
   - Alabama.
   - Illinois.
   - Utah.
   - Washington.

materials:

implementation:

Activities: (continued)

3. The percentage of reactors which will be put into use in the coming years will:
   - Decrease.
   - Increase.
   - Stay the same.

4. Most uranium mines are found in:
   - Arkansas.
   - New York.
   - Pennsylvania.
   - Wyoming.

5. The operable number of nuclear kilowatts represents which percentage of the 1977 total electrical utility capacity?
   - About 9%
   - About 20%
   - About 42%
   - About 59%

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to complete the necessary research, the student will be able to discuss the employment opportunities offered by new nuclear plant construction, i.e. types of jobs, pay scales, skilled jobs, semi- or unskilled jobs, etc.

materials:

Activity 1: Evaluation can be made by correcting the questions using the answer key which is included.

Activity 2: This quiz is optional.

SUGGESTED ASSESSMENT PROCEDURE:

Given the background knowledge, the student will be able to answer a number of questions related to nuclear plant location.

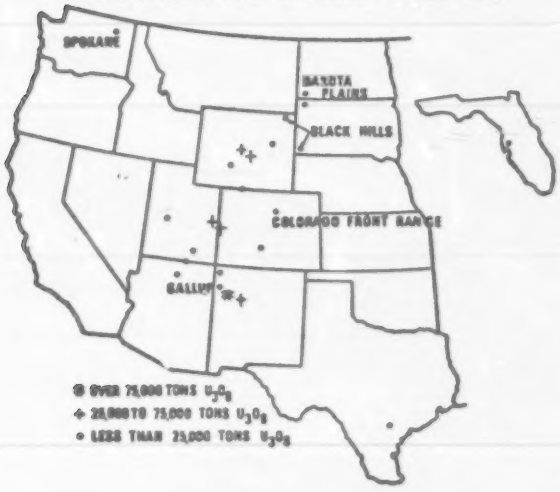
Developed by: Lynn Nixon
Seattle, WA

Revised by: Duane K. Altig

NUCLEAR PLANTS OPERABLE, UNDER CONSTRUCTION, OR PROPOSED AT THE BEGINNING OF 1978

Operable Nuclear Plant Capacity As Of December, 1977: 49,882,000 kilowatts (approx)
Total Electrical Utility Capacity As Of December, 1977: 557,119,000 kilowatts (approx)

URANIUM DEPOSITS IN THE UNITED STATES 1965



Possible Answers To Questions on Nuclear Plant Locations

1. a) Most of the existing and proposed nuclear plants are located in the eastern part of the United States.

   b) The states which have the most existing and proposed plants are:
   New York and Illinois (14 each)

2. 36 operating in 1973

3. $\frac{36}{172} = \frac{X}{100}$ _____ 20.9%

4. $\frac{56}{172} = \frac{X}{100}$ _____ 32.6%

5. $\frac{80}{172} = \frac{X}{100}$ _____ 46.5%

6. The percentages are increasing as one looks to the future so it could be concluded that nuclear reactors will provide more and more of our energy requirements.

7. West Coast and mountainous regions have hydro power and can use this to produce electricity, whereas the East Coast does not have this advantage. Also, the East Coast has a higher population density and requires more energy than most other parts of the United States.

8. Uranium is mined in states which have only one nuclear power plant between all of them and <u>not</u> in the states which have the majority of nuclear plants.

9. Areas which have uranium are mountainous and so these areas have hydro power and low density of people: therefore, the need for nuclear power is small if at all.

10. $\frac{169,202,400}{399,606,000} = \frac{X}{100}$ or rounded off $\frac{169}{400} = \frac{X}{100}$

$$400X = 16,900$$
$$X = \text{about } 42\%$$

More evidence that nuclear energy is a growing and important source of future energy.

<u>Answers to Quiz on Nuclear Plant Locations</u>

1. East Coast
2. Illinois
3. Increase
4. Wyoming
5. About 9%

title: "Dispose or Recycle?"

future ?

concept: Future energy technologies may provide abundant energy with which to modify the environment.

objective: Given the opportunity to identify disposable items, the student will be able to identify the significance and possibilities of recycling.

time: 4-5 45 minute class periods

subject matter area: All

grade: 7-9

implementation:

Activity:

1. Discuss with the class the abundance of disposable or throw away items available to the consumer.
2. Have each student bring to class items from home which are classed as disposable.
3. Construct a bulletin board of all these items. (A collage arrangement is very effective.)
4. When the board is completed, have each student identify the items and identify the energy source and material (resources) which were used in the items manufacture.
5. Compare lists in class and correct all mistakes. Now have each student suggest a possible alternative for the items listed.
6. Discuss the recycling possibilities and the rationale for recycling.

materials:

activity no. 4

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implementation:

Activities: (continued)

7. Discuss the question, "Does recycling increase the use of disposable items and thereby increase the use of energy sources?"

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify several recycling operations, the student will be able to identify two occupations in recycling which match the students interests and aptitudes.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to identify a variety of disposable items, the student will be able to identify the significance and possibilities of recycling as it relates to energy technologies.

Developed by: Duane K. Altig
Parkrose School Dist.
Portland, OR

title: "Power Consumption At Home"

future ?

concept: Energy availability will affect future lifestyles and cultural conditions.

objective: Given the opportunity to complete a learning activity package, the student will be able to relate the results of possible electrical power consumption changes in a private residence.

time: Variable

subject matter area: Mathematics, Science

grade: 7-9

implementation:

NOTE TO TEACHER:

1. The Learn to CARE energy LAP is intended to be used as a supplement to a general mathematics lesson in grade levels 6-9. Not all activities in the LAP would be appropriate for any particular grade; therefore, the following suggestions are given:
   a. Every grade level would need to read and study the short introduction, but it is perhaps better to let students discover implications of increased energy consumption as they become involved in the activities.

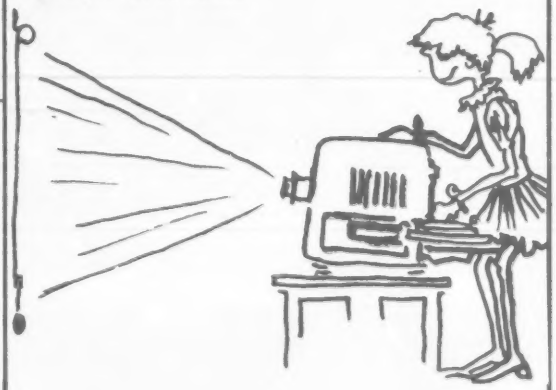
   b. Activity 1 allows for a student to gain experience in using and understanding simple statistics. Overhead transparency #1 may be used to further explain the way to make a pictorial bar graph. A teacher should encourage students to discuss and share ideas which may result from Activity 1. All grade levels 6-9 would benefit from completing Activity 1.

materials:

Student packages
Teacher resource booklet
Quiz
Transparencies

equipment:

Overhead projector



activity no. 5

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implementation:

NOTE TO TEACHER: (continued)

c. All grade levels 6-9 should be encouraged to do Activities 2 and 3. The idea of using a color TV as a unit of electrical power consumption is intended to lend some relevancy to a consumer's role in the energy situation.

d. Only the more able students in the 6th and 7th grades should be expected to do Activity 4. Most of the 8th and 9th grade students should be encouraged to attempt the completion of Activity 4. The class would perhaps profit from a group discussion about the results to the questions that are successfully completed. This discussion may develop some conclusions which will be helpful to students doing Activities 5 and 6.

e. Activities 5 and 6 are rather difficult. Only the most able 8th and 9th grade students should be encouraged to attempt these problems. Simple algebra would be helpful when solving these problems. For example: In Activity 5, let x represent the decimal which will be used to determine the per cent as follows:

(X) . (1971 amount) = (1991 amount)
(X) . (3.5) = 6
x = (6)/(3.5)
x = 1.71
so the answer is 171%

The entire class would probably benefit from a short discussion about the correct conclusions reached by the successful students.

materials:

implementation:

NOTE TO TEACHER: (continued)

f. The teacher may use Overhead Transparency #2 to discuss the request made in Activity 7. Students need to be aware that reduction in electrical power consumption can occur by reducing the total hours which an appliance or implement is operated. The appliance or implement need not be totally discarded, i.e., a color TV could be used just 2 hours each day instead of 4 hours. And the two hours need not be consecutive to accomplish a reduction by half.

g. Activity 8 has parts a and b; a student should have an opportunity to choose either part as an activity which could be considered outside of class time and then presented to the class a day or so later. Posting the complete essays or charts on the classroom bulletin board may prove to be very effective.

h. The following is a suggested time schedule:
- Activities 1, 2 and 3 used during a single 30 minute module time period.
- Activities 4, 5 and 6 used during a second separate 30 minute module time period.
- Activities 7 and 8 used during a third separate 30 minute module time period.
- A fourth module of 15 minutes to consider or discuss charts and essays completed in Activity 8.

i. Answers to LAP activity questions:
1. check graphs
2. (a) 27-1/2
   (b) 78
   (c) answers will vary

materials:

implementation:

NOTE TO TEACHER: (continued)

3. 3
4. (a) 7380 KWH
   (b) approximately 12,546 KWH
   (c) $161.62
   (d) $549.51
5. 171%
6. 58.3%
7. (a) 3CAREs
   (b) 6273 KWH
   (c) answers will vary

j. Answers to LAP quiz:
1. check graphs
2. 7050 KWH
3. approximately 6.7%
4. answers will vary

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to select one energy consuming appliance from their home and list all the occupations connected with the development, manufacture, and sale of the appliance, the student will be able to complete or individual research projects which would develop the idea of a substitute appliance and the differences in occupations between the two appliances.

materials:

SUGGESTED ASSESSMENT ACTIVITY:

Given the opportunity to complete a LAP (Learn To Care), the student will be able to participate in class discussions and complete a quiz related to the completed LAP activities.

Developed by: Anthony Jongejan
Dale Schultz
Everett School Dist.
Everett, WA

Transparency I

CHART I

AVERAGE KWH USE PER APPLIANCE IN A HOME DURING 1991

APPLIANCE	KWH
Air conditioner (used only on hot days)	935
Cooking appliances (average for all croking)	1750
Dishwasher (once a day)	430
Food freezer	1760
Lighting (5 hours per day)	1500
Refrigerator	1850
Television (color) (4 hours per day)	525
Television (black & white) (4 hours per day)	360
Electric blanket	150
Can opener (3 uses per day)	0.3
Clock	17
Clothes dryer (6 loads per week)	1200
Coffee maker (once per day)	100
Fan (stove exhaust) (1 hour per day)	30
Food mixer (1 hour per week)	10
Food wast disposer	30
Frying pan (1 use per day)	240
Hair dryer (1 use per week)	15
Iron (hand) (3 uses per week)	150
Radio (solid state) (2 hours per day)	20
Radio phonograph (solid state) (2 hours per day)	40
Sewing machine (3 hours per week)	10
Shaver	0.6
Toaster (6 minutes per day)	40
Vacuum cleaner (4 times a week)	45
Washer (automatic) (6 loads per week) (not including hot water)	100
TOTAL	11,307.9

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activities

CHART II

MY PROPOSED 50% REDUCTION IN HOME ELECTRICAL ENERGY USE

Appliance	KWH	NUMBER	TOTAL KWH
Lighting	1500	1*	1500*
Air conditioner	935	_____	_____
Cooking appliances	1750	_____	_____
Dishwasher	430	_____	_____
Food freezer	1760	_____	_____
Refrigerator	1850	_____	_____
Television (color)	535	_____	_____
Television (black & white)	360	_____	_____
Electric blanket	150	_____	_____
Can opener	0.3	_____	_____
Clock	17	_____	_____
Clothes dryer	1200	_____	_____
Coffee maker	100	_____	_____
Fan (stove exhaust)	30	_____	_____
Food mixer	10	_____	_____
Food waste disposer	30	_____	_____
Frying pan	240	_____	_____
Hair dryer	15	_____	_____
Iron (hand)	150	_____	_____
Radio (solid state)	20	_____	_____
Radio phonograph (solid state)	40	_____	_____
Sewing machine	10	_____	_____
Shaver	0.6	_____	_____
Toaster	40	_____	_____
Vacuum cleaner	45	_____	_____
Washer (automatic)	100	_____	_____
		Grand Total	_____

*We are suggesting 1500; you may want to use less.

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activities

CHART III

MY FAMILY'S CURRENT ELECTRIC ENERGY USE FOR APPLIANCES

APPLIANCE	KWH	NUMBER	TOTAL KWH
Lighting	1500		
Air conditioner	935		
Cooking appliances	1750		
Dishwasher	430		
Food freezer	1760		
Refrigerator	1850		
Television (color)	535		
Television (black & white)	360		
Electric blanket	150		
Can opener	0.3		
Clock	17		
Clothes dryer	1200		
Coffee maker	100		
Fan (stove exhaust)	30		
Food mixer	10		
Food waste disposer	30		
Frying pan	240		
Hair dryer	15		
Iron (hand)	150		
Radio (solid state)	20		
Radio phonograph (solid state)	40		
Sewing machine	10		
Shaver	0.6		
Toaster	40		
Vacuum cleaner	45		
Washer (automatic)	100		
		Grand Total	

FUTURE

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activities

STUDENT L.A.P.

FOR LEARN TO

"CARE"

In 1951 an average American family home consumed enough electricity to allow for the highest standard of living any people in the world had ever known. For example, by 1951 nearly 1/2 of the American homes had a TV set.

Let us refer to the total amount of electrical energy used by a home in 1951 as 1 CARE. CARE means: Consumption Annually of a Residence's Electricity.

The American electrical companies tell us that in 1961 each family in America used about 2 CAREs. As a matter of fact, these companies who provide the homes with electricity also give us the following information:

Year	Amount of CARE used in a home
1971	3 1/2
1981	4 1/2
1991	6

ACTIVITIES:

(1) Using the information provided by the electrical companies, complete the graph on this page by drawing taller houses to show the extra amount of electrical energy a home now uses or will probably be using in future years.

(2) The electrical energy needed for 1 CARE will operate about 13 color TVs for a whole year. (a) How many color TVs would a home's energy consumption operate in 1971? (b) How many in 1991? (c) How old will you be in 1991?

(3) How many times greater will a home's electrical energy consumption be in 1991 than 1961?

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activities

(4) In 1971 the average kilowatt-hours used by a home per month was about 615 KWH.

(a) What was the average total KWH a home used for the entire year in 1971?
(b) What will be the average total KWH used by a home in 1991?
(c) If each KWH cost 2.19¢ in 1971, what was the average home's cost for electrical energy in 1971?
(c) If the cost for each KWH should double by 1991, what will be the average home's cost for electrical energy in 1991?

(5) What per cent of the total electrical energy that was used by a home in 1971 will be used by a home in 1991?

(6) What per cent of the total electrical energy that will be used by a home in 1991 was used by a home in 1971?

(7) It is possible that by 1991 we will be required to reduce our home's electrical consumption because of shortages.

(a) If you are required to reduce your home's electrical consumption by 50% in 1991, what will be the total CAREs you will be allowed to use in one year?
(b) How many KWH will you then be allowed to use?
(c) Using Chart I as a source for your data, fill out Chart II to show how you would reduce your electrical energy use the required 50%. The kilowatt-hours indicated on Chart I are average use, so you may choose all or a fractional part of any appliance. Fractional parts would indicate less than average use. (An example might be a color television that you will watch less--instead of 4 hours a day, you will watch it 2 hours a day, or 1/2 the time. The NUMBER is 1/2 and TOTAL KWH is 1/2 · (525) or about 263.)

(8) Do activity (a) or (b).

(a) Use your best imagination to write a short essay which would describe the effect your reduction of electrical energy use would probably have on the way your family would need to live. Consider your daily routine, and also such special times as Christmas, Easter, the 4th of July, Thanksgiving, hot summer days and cold winter nights.

(b) We all have electrical appliances in our homes, so go home tonight and fill in the chart indicating how many of each electrical appliances you have. (You may use fractions if you feel your family uses this less than most people do.) Then calculate the total KWH your family is currently using for electrical appliances. Is your family above or below the 1971 average?

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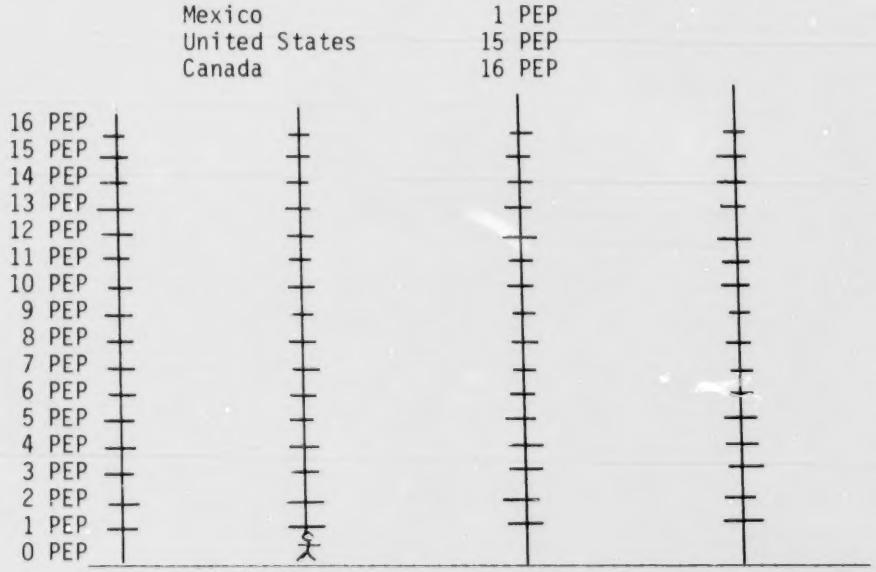
LEARN TO CARE QUIZ

(1) Suppose our friend Pedro who lives in Mexico used 1 PEP of electricity. PEP means: Pedro's Electrical Power. When we use statistics collected in 1968, we find that each Jack and Jill in the United States used 15 PEPs. Using the following chart, finish the pictorial bar graph by drawing a stick-man of proper height.

Annual Electrical Power Use Per Each Citizen



(2) 1 PEP means about 470 KWH (kilowatt-hours). Using the statistics provided in Problem 1, find the number of KWH used by each person in the United States.

(3) Use 1 PEP for a citizen in Mexico and 15 PEP's for a citizen in the United States. A Mexican citizen uses 1/15 the electrical energy that an American citizen uses. What percent is this?

(4)

Home Appliance	Annual Energy Consumption (Kilowatt-hours)
Electric blanket	150
Radio	20
Radio phonograph	40
Color TV	540
Home lights	1000
Toaster	40

Consider the chart and determine which of the above appliances you would use less if your home's electrical power was reduced or rationed by the electrical power companies because of an electrical power shortage.

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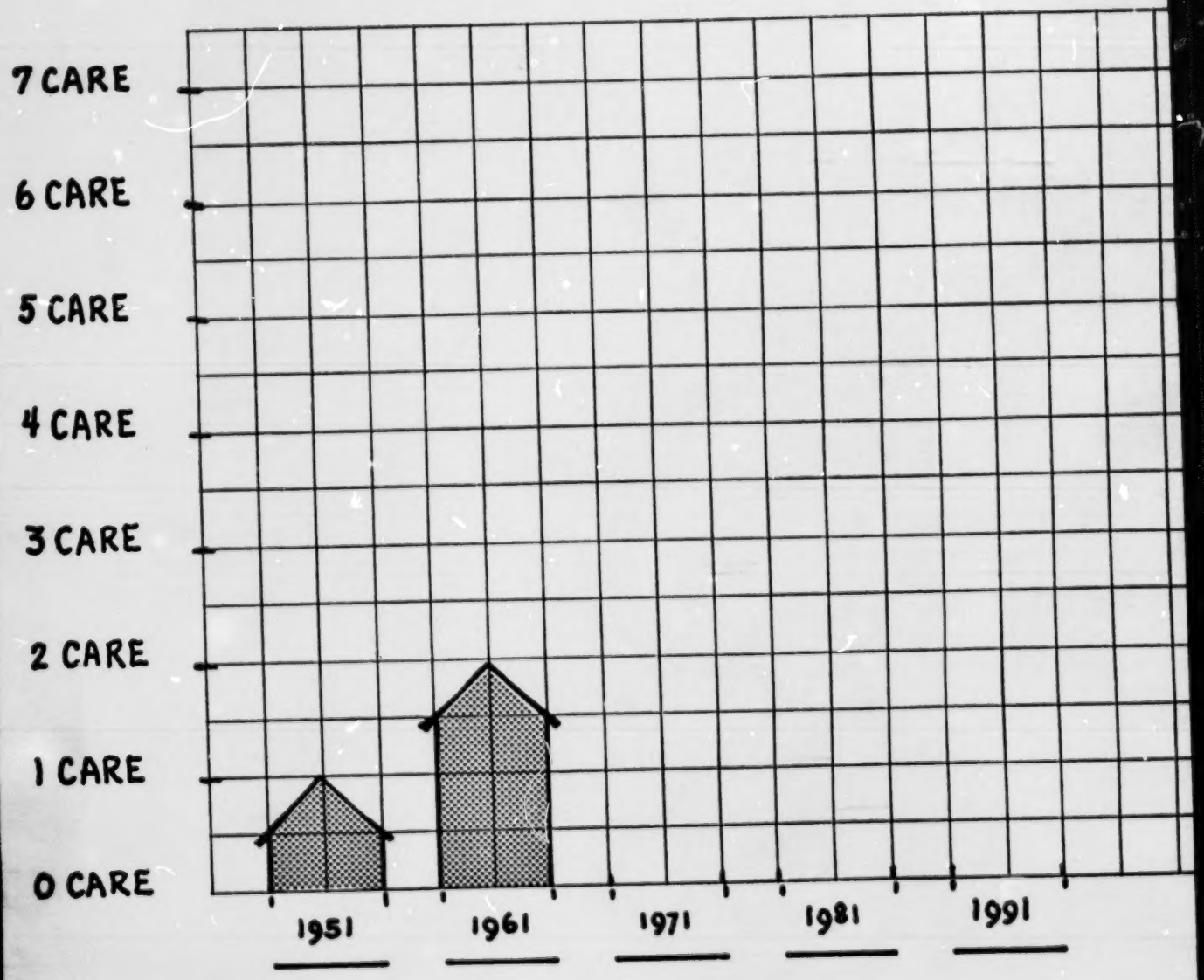
7 CARE
6 CARE
5 CARE
4 CARE
3 CARE
2 CARE
1 CARE
0 CARE
1951
1961
1971
1981
1991

FUTURE

title: "A Change In Vacation Plans"

future ?

concept: Energy availability will affect future lifestyles and cultural conditions.

objective: Given the opportunity to plan an "ideal" vacation, the student will be able to identify the effects of a loss of energy sources on their lifestyles.

time: 3-4 45 minute class periods

subject matter area: Social Science, Language Arts

grade: 7-9

implementation:

Activity:

1. Have the students plan their own "ideal" vacation (14 days only).

2. Inform the students that their plans must include:
   a. Modes of transportation.
   b. Duration of travel.
   c. Stop-over sites and length of time spent at each site.
   d. Routes of travel.
   e. Plans for recreation or enjoyment.

3. After plans are completed have the students identify all the sources of energy used during the vacation trip.

4. Have the class discuss the depletion of the energy sources of oil, gas, and coal.

5. Have the students replan their "ideal" vacation without the use of the energy sources of coal, gas, and oil. Try to complete the original trip as much as possible.

materials:

activity no. 9

implementation:

Activities: (continued)

6. Have the students write their impressions of the influences of energy on their lifestyles - use their ideal trips as an example.

SUGGESTED CAREER EDUCATION ACTIVITY:

Given the opportunity to identify decisions made in an individual work role, the student will be able to identify the influences of work decisions on the individual's lifestyle.

materials:

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to plan the "ideal" vacation, the student will be able to identify in writing the effects a loss of energy sources would have on the general lifestyle of an individual.

Developed by: Duane K. Altig
Parkrose School Dist.
Portland, OR

title: "Jobs In The Future"

future ?

concept: Future energy development will require new job skills.

objective: Given the opportunity to listen to interviews, the student will be able to identify the necessary skills that will be required of future energy related occupations.

time: 3-4 45 minute class periods

subject matter area: All

grade: 7-9

implementation:

Activity:

1. Invite speakers to the class to discuss future jobs in energy related fields. Or have students tape record interviews with individuals employed in energy related occupations.
2. The student will ask questions of the speaker or during the taped interview. The questions should relate to skill requirements for jobs.
3. Students will do additional research to identify skills necessary for future energy occupations.
4. Have student identify a plan to develop the skills needed for one future energy occupation.

materials:

Tape (cassettes)
Tape recorder, player

SUGGESTED ASSESSMENT PROCEDURE:

Given the opportunity to identify the needed skills for a future energy-related occupation, the student will be able to develop a plan to acquire the necessary skills.

Developed by: Duane K. Altig
Parkrose School Dist.
Portland, OR

activity no. 7

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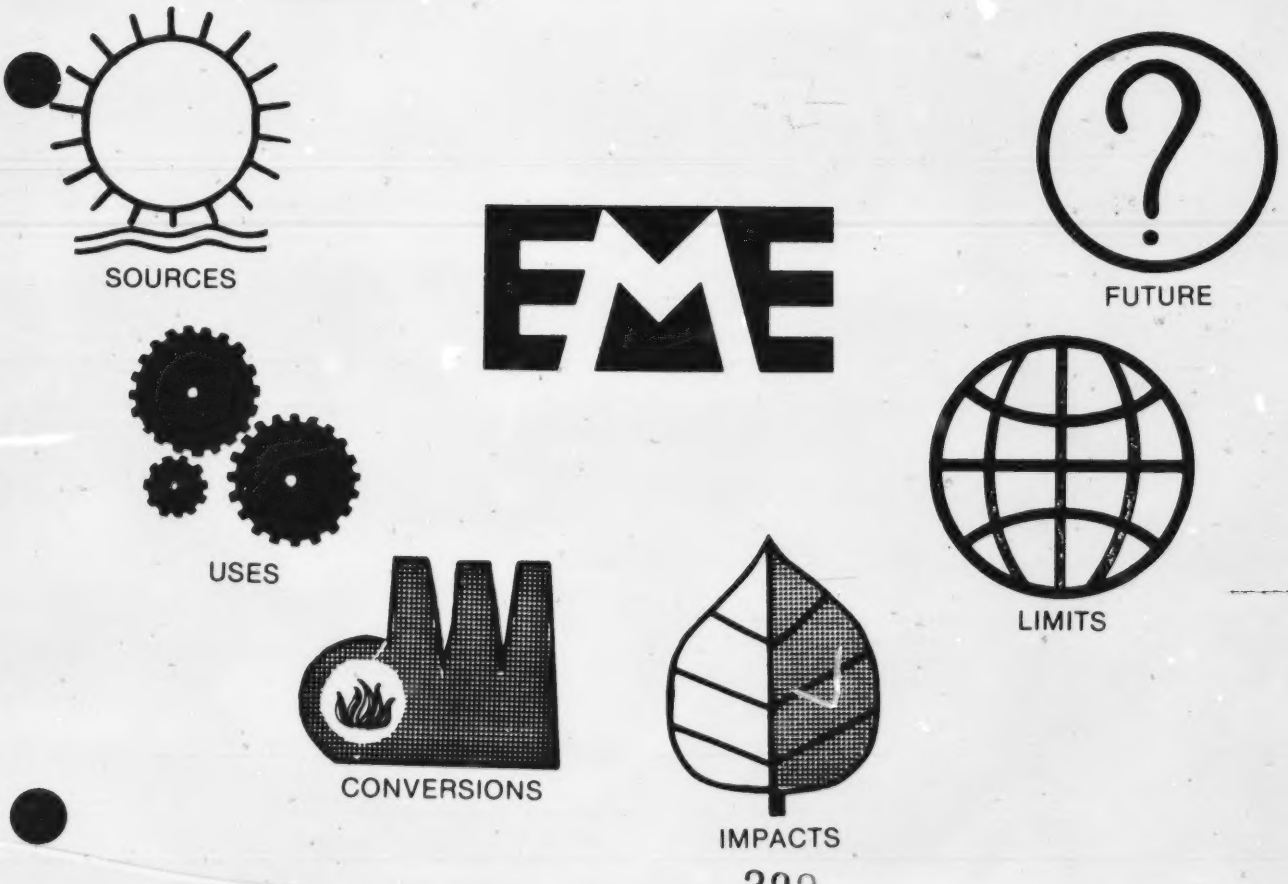
STUDENT ASSESSMENT

ENERGY AND CONSERVATION EDUCATION

Activities for the Classroom

Grades 7-9



Using The Suggested Test Items

The following test items are examples only and are not intended to be the final assessment for the entire notebook. The instructor may wish to select questions from this list to judge the preparedness of the students or to use as a nucleus for a final test covering all areas of the notebook.

Origin Of Test Items

Each test item is derived from a corresponding learning activity. For example, a suggested test item has been prepared from Sources, Activity #1. A test item has been suggested for each activity.

Type Of Suggested Test Items

Most of the test items are multiple choice, true or false, completion, "fill in the blank," or class discussion questions. For the convenience of the teacher, a "key" has been prepared, giving the answer to each question.

SOURCES:

Activity #1

1. Wind as a source of power
   a. - is desirable.
   b. - is not desirable.
   c. - is very dependable.
   d. - None of the above.

Activity #2

2. Which one of the following is not a source of energy used in providing daily essential needs?
   a. - natural gas.
   b. - coal.
   c. - petroleum.
   d. - None of the above.

Activity #3

3. The fact that the sun is a potential energy source can be demonstrated by
   a. - burning paper with a magnifying glass.
   b. - freezing ice in a refrigerator.
   c. - mining coal by the open pit method.
   d. - None of the above.

Activity #4

4. A recognition of the supply of energy as a universal problem is indicated by
   a. - higher costs for energy.
   b. - increase in use of public transportation.
   c. - both a and b.
   d. - None of the above.

Activity #5

5. In building a new home today it is possible to reduce the energy used in construction
   a. - by increasing the square foot area of the house.
   b. - by building the house underground.
   c. - by using a majority of local native materials.
   d. - None of the above.

Activity #6

6. A perfect fuel would
   a. - be limited in supply.
   b. - present no technological problems.
   c. - have adverse impact on the environment.
   d. - None of the above.

Activity #7

7. In considering the sources of energy required in providing clothing, one needs to consider
   a. - transportation.
   b. - animate power.
   c. - both a and b.
   d. - None of the above.

SUGGESTED TEST ITEMS
(7-9)

USES:

Activity #1

1. A higher electricity meter reading would indicate
   a. - an increase in the cost of electricity.
   b. - an increase in energy consumption.
   c. - a decrease in the supply of energy.
   d. - None of the above.

Activity #2

2. Which of the following is not a cause of inadequate food supplies for the world's population?
   a. - overpopulation.
   b. - lack of water.
   c. - lack of fertile land.
   d. - None of the above.

Activity #3

3. Which of the following is not an energy related term?
   a. - fusion.
   b. - coal.
   c. - thermal.
   d. - None of the above.

Activity #4

4. Electrical energy is used
   a. - to drive electric trains.
   b. - to drive tractors.
   c. - to drive nails.
   d. - None of the above.

Activity #5

5. Hydrogen gas can be produced through the process of
   a. - electrolysis.
   b. - electrocution.
   c. - evolution.
   d. - None of the above.

Activity #6

6. In the manufacture of a motorcycle there is no energy consumption in the construction of the
   a. - glass parts.
   b. - plastic parts.
   c. - metal parts.
   d. - None of the above.

Activity #7

7. The statement "There is no such thing as a free lunch" means
   a. - that you always have to pay for what you eat.
   b. - that even though the meal may be free, the production of the mealcosts something in energy loss.
   c. - the government will not provide food for the needy.
   d. - None of the above.

USES:

Activity #8 8. One thing which is affected if an energy disaster occurs and limits energy consumption is the
a. - standard of living.
b. - amount of money in circulation.
c. - type of services provided.
d. - None of the above.

Activity #9 9. One of the following would not help in effective use of energy
a. - installation of storm windows.
b. - turning down the heat.
c. - installing large glass windows on a store front.
d. - None of the above.

Activity #10 10. After studying the energy input into an electrical toothbrush, one would discover that
a. - the cost of an electrical toothbrush is very high.
b. - most people use cheap toothpaste.
c. - more energy is involved in an electrical toothbrush than the electricity to run the motor.
d. - None of the above.

Activity #11 11. By reviewing the number and use of items in the home, one would find that
a. - energy could be conserved in different ways.
b. - energy is the cause of inflation.
c. - energy could be sold for more profit.
d. - None of the above.

Activity #12 12. Which of the following common home appliances require the greatest consumption of energy?
a. - water heater.
b. - freezer.
c. - refrigerator.
d. - None of the above.

Activity #13 13. Every decision made involving energy affects standards of living.
a. - True
b. - False

Activity #14 14. Leisure time activities can be judged in value by the amount of money spent on them.
a. - True
b. - False
c. - Opinion statement

CONVERSIONS:

Activity #1

1. Which of the following is related in some way to the radiometer?
   a.- Electric eye.
   b.- Plow horse.
   c.- Street car.
   d.- None of the above.

Activity #2

2. The fact that a design can be created on blueprint paper by exposure to sunlight is an example of
   a. - energy.
   b. - energy conversion.
   c. - energy conservation.
   d. - None of the above.

Activity #3

3. Energy conversions which occur in nature are
   a. - evaporation.
   b. - condensation.
   c. - both a and b.
   d. - None of the above.

Activity #4

4. An example of a conversion process which demonstrates a loss of energy would be
   a. - to use a tourniquet.
   b. - to use a tongue depressor.
   c. - to use a first aid cold-pack.
   d. - None of the above.

Activity #5

5. Describe the procedures of a simple experiment to demonstrate that conversion processes use energy or lose heat energy.

Activity #6

6. Answer the following questions.
   1. What is Heat?
   2. How is it that heat is present in chemical reactions?
   3. How can heat bring on chemical changes in substances?

Activity #7

7. List the education or training requirements of a single energy-related occupation.

Activity #8

8. Which fuel sources use the least land for storage?

SUGGESTED TEST ITEMS

(7-9)

IMPACTS:

Activity #1 1. Which of the following is the least used method of home heating?
a. - gas.
b. - oil.
c. - solar.
d. - None of the above.

Activity #2 2. What kind of fuel is used in most present day electricity generating plants?
a. - gas.
b. - coal.
c. - uranium.
d. - None of the above.

Activity #3 3. True or False: Nuclear power plant location possibilities can create strong emotional opposition.

Activity #4 4. List three (3) reactions people display when confronted with an "unwise" energy use.

Activity #5 5. List several good and bad uses of energy, as related to our energy-intensive lifestyle.

Activity #6 6. Zoning laws create interaction with
a. - aesthetic ideals.
b. - energy requirements.
c. - both a and b.
d. - None of the above.

Activity #7 7. How do traditional values obstruct the formulation of sound, comprenhensive energy policies?

Activity #8 8. Name two (2) types of air pollution and describe plans for reduction of the pollutants.

Activity #9 9. Select one household chore or activity, discuss the changes which have occured from past to present and relate how the changes have affected the environment.

Activity #10 10. Land use plans often are influenced by
a. - personal attitudes.
b. - personal accomplishments.
c. - personal freedoms.
d. - None of the above.

LIMITS:

Activity #1

1. List five (5) activities which would cease or be eliminated by the depletion of one energy source.

Activity #2

2. In what ways is the earth like and not like a spaceship?

Activity #3

3. Discuss the statement "As world populations increase and higher standards of living develop, it becomes vital to practice conservation of natural resources".

Activity #4

4. The demand for energy has lead to a use of fossil fuels which is
   a. - increasing.
   b. - decreasing.
   c. - remaining the same.
   d. - None of the above.

Activity #5

5. List ten (10) factors related to the energy dilemma.

Activity #6

6. The supply of one of the following resources is finite
   a. - petroleum.
   b. - sunlight.
   c. - both a and b.
   d. - None of the above.

Activity #7

7. As world populations increase, the consumption of energy
   a. - remains the same.
   b. - increases.
   c. - decreases.
   d. - None of the above.

FUTURE:

Activity #1 1. List three (3) reasons why solar radiation may be a potential answer to energy needs.

Activity #2 2. What are the particles in the nucleus?

Activity #3 3. Which of the following states has more nuclear plants than the other ones listed?
a. - Alabama.
b. - Illinois.
c. - Utah.
d. - None of the above.

Activity #4 4. Discuss the question; "Does recycling increase the use of disposable items and thereby increase the use of energy sources?"

Activity #5 5. How many times greater will a home's electrical energy consumption be in 1991 than 1961?

Activity #6 6. Describe in writing what effect a loss of energy sources would have on the general leisure lifestyle of an individual.

Activity #7 7. Identify four (4) skills necessary to an energy related occupation of your choice.

SUGGESTED TEST ITEM
TEACHER'S ANSWER KEY
(7-9)

SOURCES

1. b
2. d
3. a
4. a
5. c
6. b
7. c

IMPACTS

1. c
2. b
3. True
4. answers will vary
5. answers will vary
6. c
7. answers will vary
8. answers will vary
9. answers will vary
10. a

USES

1. b
2. d
3. d
4. a
5. a
6. d
7. b
8. a
9. c
10. c
11. a
12. a
13. True
14. Opinion statement

LIMITS

1. answers will vary
2. answers will vary
3. answers will vary
4. a
5. answers will vary
6. a
7. b

FUTURE

1. answers will vary
2. protons and neutrons
3. b
4. answers will vary
5. three
6. answers will vary
7. answers will vary

CONVERSIONS

1. a
2. b
3. c
4. c
5. answers will vary
6. 1. molecular motion
   2. the movement or re-arrangement of molecules produces heat.
   3. speeds up the molecules so that they rearrange themselves or form new substances.
7. answers will vary
8. nuclear and gas